BRITISH PLANT GALLS

E. W. SWANTON

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HYMENOPTEROUS GALLS ON ROSE LEAVES CAUSED BY SPECIES OF RHODITES

BRITISH PLANT-GALLS

A CLASSIFIED TEXTBOOK OF CECIDOLOGY

BY

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WITH INTRODUCTION BY

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AND

SIXTEEN COLOURED PLATES

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PREFACE

THE principal facts as regards the galls which are developed on plants and trees, and which present such various forms, have long been recognized, since they are, for the most part, very conspicuous. It is, however, only recently that they have become the objects of special study, and there is yet much concerning them which needs further investigation.

Although during quite recent years much has been written respecting them and several valuable works have been published, chiefly on the Continent, a text-book with a classified descriptive catalogue of British galls was needed, and will be welcomed. The preparation of it, I feel sure, could not have fallen into better hands than those of Mr. E. W. Swanton. It demands a knowledge both of plant life and that of insects. Of both of these Mr. Swanton possesses, I know, a sound and extensive knowledge. His little treatise on Fungi is well known and widely read.

It is not long since the writers on insect galls, almost without exception, were in the habit of speaking of them as if they were made by the insects; and although it is now generally recognized that they are the results of a sort of partnership between animal and vegetable life, the shares taken by the two forces are by no means

definitely limited. It is, in fact, one of the chief charms of the study of galls that it brings us face to face with life processes in general, and with the very varied modes of activity manifested by living material under different conditions. They are an epitome of biological facts. Some of these are very simple and others complex, but in no department of our subject are we allowed to forget that we have to deal with the activities of life. The breadth of the subject is, indeed, to most minds one of its chief attractions.

The student of entomology having identified the varied forms of fly, moth, and beetle, each in their varied stages, which concern themselves in gall production, finds himself at once obliged to recognize also the different proclivities of growth tendencies, not only of different plants, but of different parts of the same plant, and becomes a student of botany in its several departments. There is, however, no limitation in our topics, for having obtained a good insight into both botany and entomology, the observer will soon become convinced that, in addition to them, he is obliged to study and recognize the ever-varying influence of seasons and weather. We may anticipate for the study of galls that it will soon become one of the most attractive and fascinating branches of natural history. It lends itself to the collector with especial attractiveness, for many kinds of galls are very easily preserved, and a series should form part of the possessions of every student. It is at once easy and difficult; easy as regards its principles, but full of detail as regards their application.

In the formation of a "spangle" on an Oak leaf, a

"nail" gall on a Beech, or the still more marvellous structure of a "pineapple" gall on a Spruce, we have to observe in all, and especially perhaps in the last, not so much the production of new growths as the marvellous modifications of special local endowments. The close resemblance of the "pineapple" gall, which results from the presence of the eggs of an aphis, to the cones that result from the impregnated seeds of the tree itself, is a fact which must ever excite the wonder of the observer.

It is true that at the outset a certain sentiment of repulsion is caused by the fact that the processes which we are investigating must be regarded as the results of violence, and, in a certain sense, of disease. Whilst we learn, however, that there is no protective agency at work in Nature which can compel the consistent progress of any living structure to continue in its apparently predestined course, and to protect it against the attacks of other forms of life, we find some consolation in observing the wonderful and frequently very beautiful adaptations which these deranged manifestations often assume, and at the same time we are invariably compelled to marvel at the wonderfully varied forms of manifestation which "Nature's moulds," under the stimulus supplied, can be made to evolve.

I will confess that I am somewhat reluctant to include under the term "galls" certain infectious growths, known in America under the name of "crown galls," about which very interesting information has recently been accumulated in the United States. They are infective outgrowths, which have but little alliance with the rest of the group, and have close alliance to

certain infective forms of inflammation, and perhaps to some forms of tuberculosis. It is impossible to exclude them by any definition; at the same time their comprehension under the name of "galls" will probably be very inconvenient and productive of much confusion. They should, I think, be allowed to constitute a separate group, and with them should be placed the diseases known in England under the name of "canker."

A gall in its special but now well-recognized meaning of the word may be defined as a growth on a plant or tree caused by the deposit of an insect egg in process of development, or by the presence of a fungus. The special kind of gall produced will depend upon the endowments of the part in which the irritation occurs, and will vary not only with the kind of plant, but with the minute details of vital endowment of the part. Thus it will be influenced by the precise part of the stem, leaf, or bud which is attacked. The conditions which are favourable to galls of all kinds are active vitality on the part of the plant, free supply of sap to the special part affected, and seasonal conditions of warmth.

The Oak, of all trees, produces probably not only the greatest variety of gall structures, but the greatest abundance of individual forms.

It must be acknowledged that there is much in reference to peculiarities in different galls which is as yet ill understood. There is no doubt that the nature of the gall produced is influenced not only, although chiefly, by the special endowments of the plant attacked, but also by the character of the irritation which attacks *it*.

Thus the peculiar features of a gall may predicate conclusively in many cases the insect which has caused it, whilst in many others they may imply with equal clearness that of the plant attacked, and the special tissue of the plant which has been implicated. The aphis galls on the Spruce Fir are especially instructive in this respect.

It is worthy of remark that it is possible that, after all, the production of local warmth is the immediate efficient in the causation of insect galls. Although it is only conceivable as being very small in amount, there is no doubt that a development of eggs, as of all other local processes attended by growth, is productive of local warmth. It may not be easily appreciable, and may be impossible of measurement, but it must be recognized as a constant condition.

It gives me particular pleasure to recommend a work on the subject of galls from the pen of my friend Mr. Swanton, because I know that not only has he been for many years a zealous collector of facts respecting them, but that I know that he is well informed as to the special branches of natural history which are involved in their study. He is no specialist restricted to one branch of natural history, but a specialist alike in botany, entomology, and general biological science.

JONATHAN HUTCHINSON

HASLEMERE, 1912

AUTHOR'S NOTE

THE galls arising in plant tissues through the presence of parasitic insects and fungi are of peculiar interest and significance, and offer a most attractive field of investigation, abounding in problems awaiting elucidation, some of them of great economic importance.

It was my first intention to publish a descriptive catalogue only. The volume has assumed its present form in the desire to meet the wishes of those who assured me that some introductory chapters were needed. I have not attempted any detailed consideration of the morphology, etiology, and biology of galls; such may be found in Dr. Kuster's recent book, "Die Gallen der Pflanzen."

I wish to offer my sincerest thanks to many friends whose names appear in the following pages—in particular, to Sir Jonathan Hutchinson, who has kindly contributed the preface and loaned several blocks; to the Rev. E. N. Bloomfield for much help, especially in the preparation of the notes on dipterous galls, and to Miss Mary K. Spittal for the great trouble she has taken in the preparation of the most excellent coloured plates. It is worthy of note that this is the first book to give coloured illustrations of galls other than those occurring on the Oak. I hope that readers will assist towards

the preparation of the second edition of the catalogue by sending me galls not mentioned therein. They should be packed in tin boxes, and full particulars should accompany them. If an answer is required, a stamped and addressed postcard should be enclosed.

E. W. SWANTON

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Those in colour are marked with an asterisk

NOTE.—*The line intended to serve as an index to the size of the insect is in all cases one-third in excess of the actual length.*

BRITISH GALLS

CHAPTER I

INTRODUCTION

THE remarkable hypertrophies of plant tissues with which this volume is concerned have been termed "galls" from early times. The Greek naturalist and philosopher Theophrastus (372-286 B.C.) alluded to the superior quality of the gall-nuts of Syria. Then, as now, the Aleppo gall * was a valuable article of trade. Two well-known writers of the first century A.D. also alluded to them—viz., the Greek surgeon Dioscorides and the Roman naturalist Pliny the Elder. The true cause of the origin of these growths was quite unknown until comparatively recent times. Dr. Peter Matthiolus, a physician of great repute in the sixteenth century, ascribed their origin to spontaneous generation, and asserted that important events could be foretold by carefully examining the contents of galls. These views were upheld by the botanists (herbalists) of that time. Gerard wrote: "The Oke-apples being broken asunder do foreshew the sequell of the yeare, as the expert Kentish husbandmen have observed by the living things found in them: as if they found an ant, they foretell plenty of graine to ensue; if a white worm or magot, murren of beasts and cattell; if a spider, then, say they, we shall have a pestilence or some such-like sickness amongst men." The authors of a

* Caused by *Cynips tinctoria* Oliv. chiefly on *Quercus infectoria* Oliv. Nearly 800 tons of these Galls were imported in 1861.

book on husbandry called the "Country Farme" (1616) gravely inform the reader that "he shall know a fruitfull and fertile yeare if he see the Oke-apples, commonly called Gals." A curious superstition of Gerard's day in connexion with morbid growths on trees survives to this day in some parts of South-West Surrey, where old people still carry a little woody tumour from the trunk of an Oak or other tree as a safeguard against cramp. These cramp-balls, "crambles" in the vernacular, are of common occurrence on Oak, Beech, and Holly trunks, and usually vary in size from that of a marble to that of a walnut. A cramp-ball now in the Haslemere Museum had been carried fifteen years by an old man still living in Haslemere.

Apparently John Evelyn the Diarist was acquainted only with commercial galls, for he remarked in his "Sylva" (1664): "*Pliny* affirms, That the *Galls* break out all together in one *Night*, about the Beginning of *June*, and arrive to their full Growth in one Day, this I should recommend to the experience of some extraordinary vigilant *Woodman*, had we any of our *Oaks* that produced them, *Italy* and *Spain* being the nearest that do. Galls are of several kinds, but grow upon a different *Species* of *Robur* from any of ours, which never arrive to any maturity."

That keen observer Sir Thomas Browne noted, however, that the Oak produced several kinds of galls. Writing to his friend Dr. Merrett in 1668, he remarked: "A paragraph might probably be annexed unto Quercus. Though wee have not all the exotic oakes nor their excretions, yet these and probably more supercrescences productions or excretions may bee observed in England." He proceeded to give a descriptive list of those which had come under his notice; some of them can be easily identified.

It is said that Dr. Martin Lister (1638-1712), the physician-in-ordinary to Queen Anne, was the first to observe that certain insects are always associated with certain galls. He found gall insects on the Plum, Cherry, Vine, etc., and alluded to them as the *patellae* of these trees.

In 1671 he discovered that from some a permanent dye of a carnation-red colour could be obtained by mixing them with ley of ashes.

The physician Marcello Malpighi (1628-1694) was the earliest systematic writer on galls. He published in 1686 a treatise, "De Gallis," concerning the galls of Italy and Sicily. His disciple was Dr. Derham, Canon of Windsor, who comments upon Malpighi's observations and his own in the notes to his Boyle Lectures (1711-12), in which he writes: "I find Italy and Sicily more luxuriant in such productions than England, at least than the parts about Upminster (where I live) are. For many, if not most, of the galls about us are taken notice of by him [Malpighi], and several others besides that I have never met with, although I have for many years as critically observed all the excrescences and other morbid tumours of vegetables as is almost possible, and do believe that few of them have escaped me." Derham was fully aware that galls may contain parasites, and quaintly remarks: "I apprehend we see many vermicules, towards the outside of many oak-apples, which I guess were not what the primitive insects laid up in the germ from which the oak-apple had its rise, but from some supervenient additional insects, laid in after the apple was grown, and whilst it was tender and soft."

That much attention was given to the subject by investigators in the latter part of the eighteenth century and early in the nineteenth is evident from a perusal of the article on "Galls" in the fifteenth volume of Rees's "Cyclopaedia," published in 1819. The author observes that galls are morbid excrescences originating from those parts of a plant that are in most vigorous growth, in consequence of the attacks of insects; that the two varieties of British Oak bear several kinds of galls; and that the main stems of the large shrubby kinds of Hawkweed *(Hieracium sabaudum* and *H. umbellatum)* are often attacked and swell into oval knots, in which, while growing, young insects may be found latent.

For subsequent bibliography the reader is referred to the index of literature.

Galls arise only from embryonic tissues which have received undue stimulus. A plant gall may be defined as abnormal growth induced by the irritation of an animal or fungus parasite. The protoplasm of cells predestined to give rise in ordinary course to the plant or its part has been so affected by the parasite that these cells deviate from their normal mode of growth, become phenomenally active, elaborate a new plan of construction, and give rise to the overgrowths familiarly known as galls. To term the parasite a "gall-maker," as many writers have done, is to convey an utterly erroneous idea of its function. It makes nothing, but induces much.

It was thought at one time that galls arose solely through the injection of an irritant by an insect, and that each insect had its own peculiar poison. Both Malpighi and Réaumur accounted for the phenomenon by the theory that it was due to an irritant injected by the insect; the latter observer also thought that the extent of the wound and the heat of the eggs were additional factors in inducing abnormal growth. The infection theory received the support of Darwin, Professor Riley, and Sir James Paget. The observations of Adler, Cameron, and others, show that in the case of the *Cynipidae* (gall wasps) no such irritant is introduced by the insect, and that the larva is the cause of the hypertrophy. Cameron remarks that the origin of gall structures cannot be explained comfortably by any one theory, the habits of the insects associated with them being so very diversified. "Even in the Hymenoptera," he writes, "we find two radical distinctions in the habits of the insects; that is to say, in the *Tenthredinidae* the gall is already formed before the larva quits the egg, while in the *Cynipidae* the birth of the larva is synchronous with the formation of the gall. Until the larva is born and commences feeding, there is no gall formation."

The observations of Burdon and others on *Chermes*

galls of the Spruce show that in these a ferment injected by the female *Chermes* is the primary cause of the abnormal growth, and that its action is not strictly localized, but spreads from cell to cell.

A particular part of a plant—for example, the leaf—may produce very dissimilar galls, even when attacked by closely related insects, as may be seen by referring to the frontispiece which depicts galls on Rose leaves, all of which are induced by species of *Rhodites*.

Galls are always remarkably constant in form, etc., even to minute peculiarities in the epidermic covering, and are thus easily recognizable, though their causers are often—especially amongst the *Cecidomyidae*—so nearly alike that it is difficult to distinguish them. In America the Willow *Salix humilis* is attacked by ten gall-gnats which cause distinctive galls, but it is almost impossible to diagnose the insects, the galls affording the best clue to specific identity.

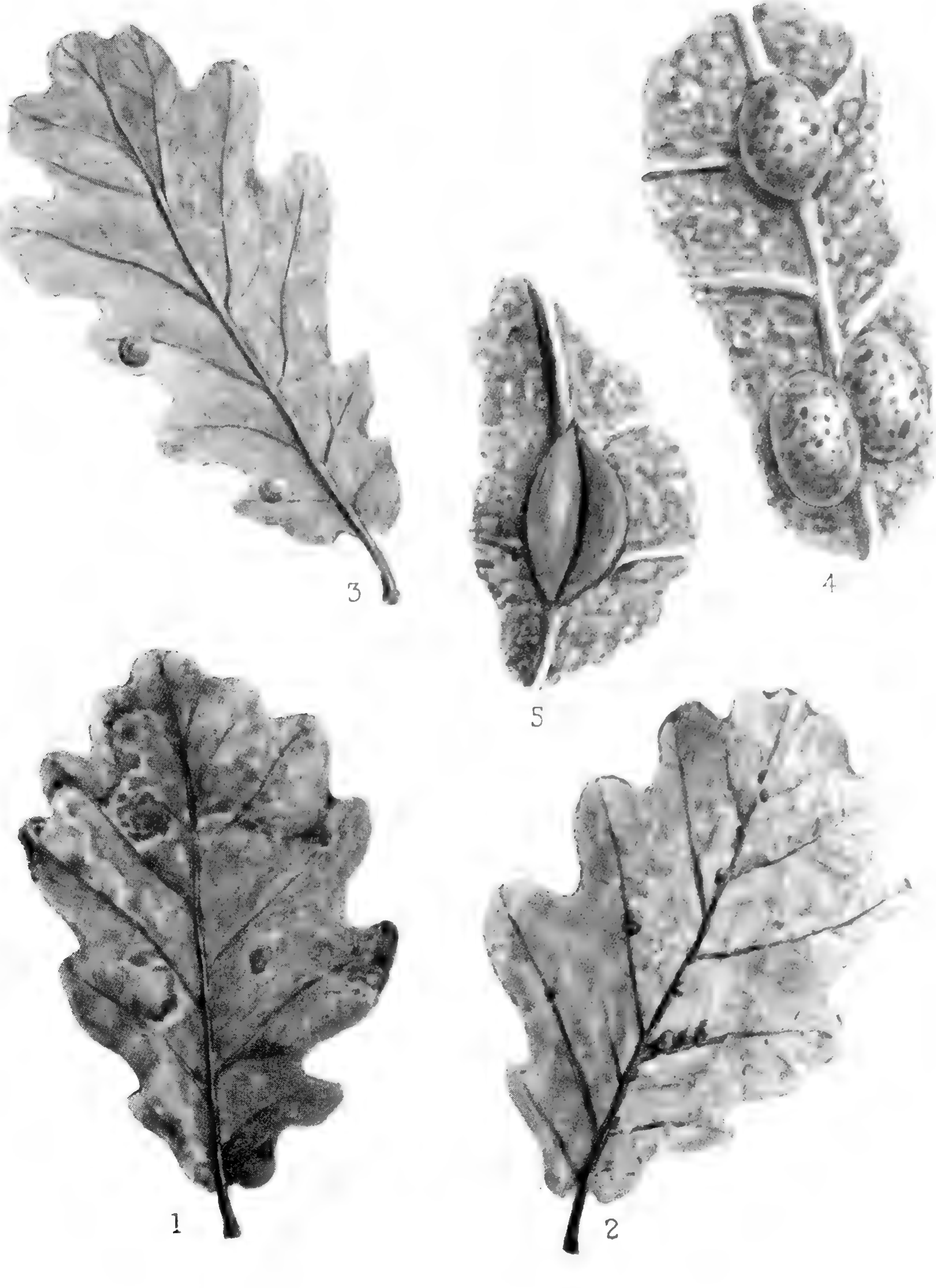
Galls are not transmissible to the descendants of the plant producing them. A tree grown from a seed of a Birch much infested with mites will not produce "witches' brooms," unless it is visited by mites of the particular species which causes them. The interesting questions of the undoubted susceptibility of some trees to the attacks of parasites, and the comparative immunity of others of the same species, deserve careful investigation. A Birch tree laden with "witches' brooms," and having its branches in actual contact with those of another Birch quite free from them, is no uncommon spectacle. It may be suspected that the descendants of the former would show the same predisposition to attack, and the descendants of the healthy tree the same immunity.

The so-called "oyster" gall of the Oak (caused by the presence of the larvae of *Andricus ostreus*) was extraordinarily abundant during the summer of 1911. As this gall causes, when present in large numbers, marked marginal discoloration of the leaf, non-infected trees were

easily discernible, and I noted in many places two Oaks (*Quercus pedunculata*) growing side by side under similar conditions with their branches intermingled, one bearing a profuse crop of "oyster" galls, and the other almost or quite without them. From two such trees, near the Haslemere Museum, I gathered, on August 23, two twigs at random, one from each tree. One twig had ten leaves; on these I counted 228 galls, of which no less than 188 were "oyster" galls. All the leaves were brown at the margin, and presented the conditions seen in Plate I., where Fig. 1 shows the upper surface of one of those leaves, and Fig. 2 the under surface. The other twig had fifteen leaves: none showed acroteric death; I found two spangle galls (Plate I., Fig. 3) on one and a single spangle on another. Thirteen of the fifteen leaves were entirely without galls of any kind. How is the comparative immunity of the latter tree to be explained? Is there some special substance in its plasma which has a deleterious effect upon the egg of the insect? I determined, by microscopic examination, that many of the leaves had been punctured, but no gall growth had followed.

Certain species of trees rarely produce galls upon their leaves. I may instance the Horse Chestnut. Only four galls, all obscure, are known, and none have been observed in Britain. Mr. Alfred Sich, F.E.S., the acknowledged authority on leaf-mining insects, informs me that he knows of "no leaf-miners of the Horse Chestnut in England nor Europe," a fact of great interest to cecidologists.

Peyritsch and other investigators have shown that many plants can be induced to produce double flowers (stamens changed into petals) under the stimulus of mites. Kerner gives particulars of his personal observations in the case of *Veronica officinalis*, which bore double flowers when infested with mites. He noted that ripe seeds were produced only from flowers which had remained single amongst the double ones, and that the plants from these seeds bore single flowers. But *V. officinalis* has only two stamens in each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flower, and Kerner thought it possible that double-flowered plants provided with many stamens, which have been long grown in gardens, and which produce such flowers when propagated by seeds, may have acquired this characteristic in the first place under the influence of the mites. (See notes in Chapter VII.)

Fungus galls are caused by the presence of a parasitic fungus in plant tissue. The fungus obtains entrance by means of the spore (the equivalent of the seed in the higher plants) which may be carried by wind currents or other agency to the host, and, germinating thereon, pierces its outer cells. In most cases entrance is probably more easily effected in weakly plants, but plants that are to all appearances quite healthy and vigorous may also be attacked successfully. The results of infection are very varied. The mycelium may permeate the host, produce its spores only at a late stage, and cause no appreciable overgrowth or gall formation. In some plants atrophy may result, as in Bent Grass infested with *Tilletia decipiens;* it is much dwarfed and assumes the form known as *pumila*, at one time regarded as a distinct variety. Occasionally the entire habit of the plant becomes altered, as in the case of Wood Spurge attacked by *Endophyllum euphorbiae*, when the shoots are longer and the leaves shorter and wider than those of normal plants. Modifications of habit are, however, outside the scope of this book; it is localized hypertrophy alone that comes under our definition of a gall. In some cases the overgrowth is slight, in others it is very marked. The fusiform swelling caused by the presence of *Peridermium elatinum* (the aecidial stage of *Melampsora cerastii*) in branches of Silver Firs, is a good example of the latter.

Plowright observed that the leaves of our native species of Dock (*Rumex*), when attacked by *Uromyces rumicis*, often "retain their original green colour long after the unaffected portions of the leaves have become yellow from age.' Retention of the chlorophyll is seen also in many leaves bearing insect galls—*e.g.*, the hairy tubular outgrowths

on the upper surface of Beech leaves, caused by the dipteron *Oligotrophus annulipes.* Leaves may often be picked up in late autumn which are quite brown except for a green zone around the gall. The presence of the living parasite prevents the over-oxidation of the adjacent cells and keeps them green.

Galls exhibit great diversity in form and general structure. The following arrangement of the chief types occurring on Phanerogams and Vascular Cryptogams is based on that given in Kerner and Oliver's "Natural History of Plants."

INSECT GALLS

I. SIMPLE GALLS

Abode of an animal or colony of animals on a single plant organ.

1. Felt Galls

Hypertrophied epidermal cells growing out into variously-shaped hairy coverings. The felt galls are chiefly caused by gall-mites. Very familiar examples are the variously-coloured little patches of felt on the under surface of Alder leaves.

2. Mantle Galls

Hypertrophy forming a chamber around the insect (in many cases) and its brood, serving as a protective mantle. The chamber is always lined with part of the original surface of the affected part. These galls may be arranged under three headings:

(*a*) *Scroll Galls*

Rolling and thickening of the leaf (rarely the petiole), usually on one side only. The rolling is always towards the surface occupied by the animals, thus forming a chamber for their protection. See Plate XVIII., which shows the margins of the pinnules of the Bracken rolled

inwards and thickened; each roll contains the larva of a fly, *Perrisia filicina.*

(*b*) *Pocket Galls*

Hollow protuberances arising from the tissue of the leaf lamina and forming an excavated chamber. These galls exhibit great variety of form and internal structure. Types caused by aphides (*Schizoneura* and *Tetraneura*) on Elm leaves are illustrated in Chapter VI.; others on leaves of Alder and Mealy Guelder Rose arising from stimulus by mites are shown in Plate XXI. See also the familiar nail-gall on the upper surface of Beech leaves caused by the dipteron *Oligotrophus annulipes* (Plate IX.).

(*c*) *Covering Galls*

Hollow protuberances rising around the animal, the upward growth and over-arching of the tissue finally forming a roofed-in chamber; the tissues, however, do not fuse when they meet, and they ultimately contract and shrivel, leaving a slit for the exit of the insects. A well-known example is the gall on the leaves and petioles of the common Nettle, caused by the gall-gnat *Perrisia urticae.*

3. Solid or Tubercular Galls

Hypertrophy takes place around the larva, which is hatched from an egg deposited in the tissues; hence the chamber is never lined with part of the original outer surface of the afflicted area. Amongst the numerous galls of this group may be mentioned those caused by gall-wasps on leaves of Oak, Willow, and Briar (Plates II., III. and V.).

4. Root Galls

Spherical outgrowths of variable size on the roots of many trees and plants. Some result from the attacks of eelworms, others from insect irritation. The galls on the root of the common Oak caused by *Biorrhiza aptera* (Plate IV.) are perhaps the best known.

II. COMPOUND OR BUD GALLS

Several adjacent plant organs are involved in the production of these galls, which chiefly arise from buds. "They are extraordinarily varied in their characters, some being merely abbreviated axes clothed with scale-like leaves; in others only the base of the shoot is involved, and above the gall it continues its growth quite normally; whilst in others, again, the axial portion of the structure is much swollen, and the leaves hardly represented at all" (Kerner). It is difficult to arrange them in groups, but three fairly well marked may be distinguished.

1. Bud-like Galls

Several or all the parts of a shoot are involved, its axis is deformed and thickened, and elongation is suppressed.

(a) *Modified Foliage Buds*

i. Apparently leafless, the leaves transformed into tubercles and knobs. This section includes the various bud galls of the Oak—*e.g.*, the Oak-apple caused by *Biorrhiza pallida* (Plate IV.) and swellings on Poplar branches caused by the beetle *Saperda populnea* (Plate VI.).

ii. Galls covered with scale-like bracts, or more or less fully developed green foliage leaves.

A familiar representative of this section is the Artichoke gall caused by the hymenopteron *Andricus fecundator* in Oak buds, figured in Chapter II.

(b) *Metamorphosed Flower Buds*

In these the corolla does not open; the calyx becomes enlarged and often fleshy, the gall resembling a bud or bulbil. The gall caused by the dipteron *Contarinia loti* in the flower buds of the Bird's-foot Trefoil is a typical example. See Fig. 1, p. 15.

2. Galls at Base of Shoots

The base of a shoot alone is involved; the upper part is able to continue its growth beyond the gall. This group includes the pineapple galls of the Spruce caused by aphides (Plate X.), and the spongy growths on various Bedstraws caused by the dipteron *Perrisia galii* (figured in Chapter V.), also on cruciferous plants by *Dasyneura sisymbrii*.

3. Rosette Galls

Axis of the bud much stunted, covered with densely crowded leaf structures, between which the insects live.

(*a*) *Developed in the Foliage Region*

These galls resemble a miniature rosette, double Rose, or Cabbage. Well-known examples are the rosettes at the tops of Willow twigs caused by the dipteron *Rhabdophaga rosaria*, and those on Hawthorn twigs caused by an allied insect, *Perrisia crataegi*.

(*b*) *Developed in the Floral Region*

Bunches, rosettes, and balls, take the place of flowers. Very common instances are the whitish hairy gall at the top of the shoot in the Germander Speedwell, resulting from attack by the dipteron *Perrisia veronicae* (Plate VIII.), and the tuft of crowded erect leaves at the tip of a shoot in the Yew, caused by the presence of the larvae of the dipteron *Oligotrophus taxi*. An uncommon but very distinctive gall belonging to this section is the tassel-like growth caused by the homopteron *Livia juncorum* in the heads of various Rushes.

FUNGUS GALLS

1. On Part of the Foliage Leaves

The curious galls known as "Alpine Rose-apples," frequent on the Continent on leaves of Rhododendrons

(notably *R. hirsutum* and *R. ferrugineum*) afford a striking example of this group. They are caused by *Exobasidium Rhododendri.*

2. On a Sharply Defined Part of the Stem

"Galls arising from sharply defined parts of the stem are comparatively rare. One of the most remarkable is produced on the stems of a Laurel (*Laurus canariensis*) by the parasite *Exobasidium Lauri.* When it appears above the bark it looks like an aerial root, but rapidly grows into a branched spongy body 8 to 12 cm. long, similar in appearance to one of the fungi belonging to the family Clavariae" (Kerner). The pronounced fusiform swellings on Juniper stems induced by *Gymnosporangium clavariaeforme* may also be included under this group (Plate XIX.).

3. On the Roots

To this section belong the tuberous masses on Alder roots caused by the hyphomycete *Frankiella alni* (Plate XVI.), and the well-known "finger and toe" disease of Cabbage roots caused by the myxomycete *Plasmodiophora brassicae.*

4. Floral Organs Modified

Galls belonging to this section are not common. Characteristic examples are (1) the remarkable green or reddish outgrowths—sometimes 30 mm. long—on the pistillate catkins of the Alder caused by *Exoascus alnitorquus* (figured in Chapter IX.), and (2) the curious hypertrophy of the ovaries in *Prunus domestica,* known as "bladder plums," caused by *Exoascus pruni* (Plate XXV.).

5. Branches Modified

To this group belong the curious malformations popularly known as "witches' brooms," of which, perhaps, the best

known are those induced by *Exoascus turgidus* on the Birch, and by *Peridermium elatinum* on Silver First (Plate XVII.).

Galls on Algae, Mosses, and Lichens

A. W. Bennett has described a gall occurring on the alga *Vaucheria Dillwyni* Agardh., probably caused by the rotifer *Notommata Wernecki* Ehrenb. Similar galls on various species of *Vaucheria* have been recorded by Continental observers. This gall is of very variable size and aspect, often assuming the form of an elongated capsule bearing numerous prolongations or tubercles on its surface; the causer may be discerned, with the aid of a lens, within the gall, appearing as a little black point. A copepod (*Harpacticus chelifer* O. F. Müller, according to Barton) galls *Rhodymenia palmata*, causing numerous papules on the thallus. A similar agent deforms the thallus of *Desmarestia aculeata* Lamouroux.

Connold depicted ("Plant Galls," Fig. 278) stems of *Halidrys siliqua* Lyn. with pronounced globular swellings. They were picked up on the beach at St. Leonards in 1902, between November and April, after heavy storms. "Many efforts were made to determine the cause, but without success."

Eelworms cause galls on algae and on mosses; for notes concerning these, see Chapter VIII. There is a reference in Chapter VII. to galls on lichens supposed to have been caused by mites.

The majority of the agents causing galls on British Phanerogams and vascular Cryptogams are insects included in the orders *Hymenoptera*, *Coleoptera*, *Lepidoptera*, *Diptera*, and *Homoptera*. These and the galls caused by Mites (*Acari*), Eelworms (*Nematoda*, family *Anguillulidae*), and Fungi are discussed in the following chapters. For the most part, familiar galls only are described, the text being chiefly descriptive of the plates.

Notes on Collecting and Preserving Galls

The majority of galls may be preserved easily in the dried state. They should be kept in a series of glass-topped boxes. Great care must be taken to dry them thoroughly before putting them away, and to see that they are not infested with herbarium pests. It is advisable to put a little naphthaline in each box. The collection should be supplemented with coloured drawings of the galls and their inhabitants, and with photographs. A notebook should always be carried by the cecidologist in the field, and constantly used. The necessity for continuous observation and patient jotting down of detail cannot be too strongly insisted upon. If the galls are collected at the right season, there should not be much difficulty in breeding out *Hymenoptera* and *Diptera*. A glazed cabinet will be necessary for the insects. Mites and eelworms may be preserved in alcohol in test-tubes.

Every specimen should be carefully labelled. Do not adopt the plan of simply affixing a number to the specimen and keeping the particulars posted up in the notebooks. Valuable collections, the work of a lifetime, have been either disposed of for a mere song or thrown away because the notebooks containing the keys to them had been lost.

To convey an idea of the size of galls of very variable dimensions we allude to them as being of the size of a pea, walnut, or other familiar object. This is a convenient plan, and I have followed it for such galls in this book, but I am fully aware that it is not a scientific one. It is certainly better that all measurements be given in millimetres or centimetres, as the case may be. For this purpose the most convenient, and at the same time the cheapest measuring instrument that I know of is a little clockmaker's gauge made by Boley of Esslingen.* It is a slide gauge, and reads with a vernier up to 0·1 mm.—a sufficiency of

* It may be had from Messrs. Grimshaw and Baxter, 33-37, Goswell Road, Clerkenwell, London, E.C. Price 5s.

accuracy for all ordinary purposes—and measures up to 10 cm.

In seeking expert help in identification care must be taken to state very clearly in the case of supposed fungus galls what information is desired. To my knowledge a cecidologist sent a cankerous outgrowth from a branch to a well-known mycologist asking him to identify the fungus. He examined the specimen, found a saprophyte on the bark, and sent back its name. The collector, knowing nothing about fungi, jumped to the erroneous conclusion that the saprophyte was the cause of the gall growth.

The shape, size, and position of the gall are secondary characters in diagnosis. The occupants must be examined carefully in all cases with a microscope or powerful pocket-lens, for it sometimes happens that galls of similar appearance caused by totally different creatures occur on the same species of plant. Many egregious blunders have been made (and unfortunately published) by cecidologists who have omitted to observe this elementary precaution—*e.g.*, galls caused by eelworms have been ascribed to the presence of dipterous larvae.

The collector's field outfit should consist of a good-sized vasculum ($16 \times 8 \times 4\frac{1}{2}$ inches is as handy as any), a strong pocket-knife, a stout pruning-knife, a hand-saw with adjustable blade, a few small tin boxes, and a good pocket-lens.

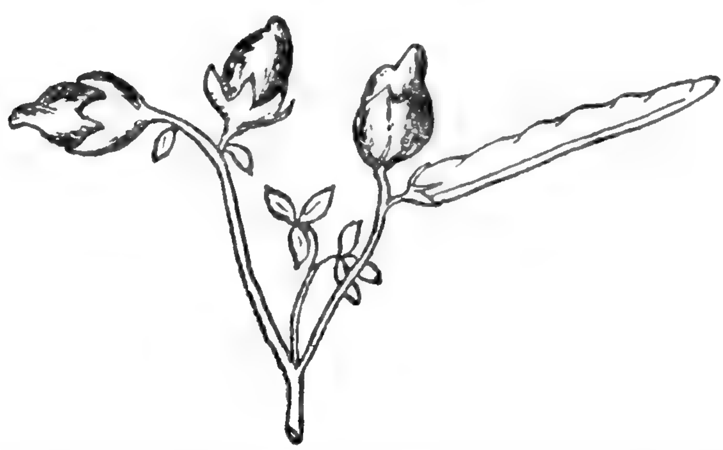


FIG. 1.—SEED PODS OF *Lotus corniculatus*, SWOLLEN AND DEFORMED THROUGH THE PRESENCE OF THE LARVAE OF *Contarinia loti*. (1/1.)

SYNOPTIC TABLE OF THE GENERA OF
ON BRITISH PHANEROGAMS

HYMENOPTERA (Wasps, Saw-flies)	**COLEOPTERA** (Beetles)	**LEPIDOPTERA** (Moths)	**DIPTERA** (Flies)
CYNIPIDAE:	CERAMBYCIDAE:	SESIIDAE:	CECIDOMYIDAE:
Andricus	Saperda	Sciapteron	Asphondylia
Aulacidea	SCOLYTIDAE:	PTEROPHORIDAE:	Atrichosema
Aulax	Hylastinus	Platyptilia	Clinodiplosis
Biorrhiza	CURCULIONIDAE:	Pterophorus	Contarinia
Callirhytis	Anthonomus	ORNEODIDAE:	Cystiphora
Cynips	Apion	Orneodes	Dasyneura
Diastrophus	Baris	PHYCITIDAE:	Diplosis
Dryophanta	Brachonyx	Dioryctria	Harmandia
Neuroterus	Ceuthorrhynchus	TORTRICIDAE:	Harmomyia
Rhodites	Mecinus	Epiblema	Lasioptera
Trigonaspis	Miarus	Grapholitha	Löwiola
CHALCIDIDAE:	CHRYSOMELIDAE:	Gypsonoma	Macrodiplosis
Isosoma	Psyllioides	Laspeyresia	Macrolabis
TENTHREDINIDAE:		Lobesia	Massalongia
Blennocampa		Pammene	Mayetiola
Cryptocampus		Phalonia	Mikiola
Micronematus		Rhyacionia	Monarthropalpus
Pontania		Tortrix	Oligotrophus
Selandria		GELECHIIDAE:	Perrisia
Trichiocampus		Stenolechia	Pseudohormomyia
		OCEOPHORIDAE:	Putoniella
		Argyresthia	Rhabdophaga
		ELACHISTIDAE:	Rhopalomyia
		Augasma	Schizomyia
		Heliozela	Stictodiplosis
		Mompha	Thecodiplosis
		NEPTICULIDAE:	MUSCIDAE:
		Nepticula	Agromyza
			Anthomyia
			Carpotricha
			Chlorops
			Lauxania
			Lipara
			Lonchaea
			Myopites
			Oscinis
			Oxyna
			Phorbia
			Tephritis
			Trypeta
			Urophora

ANIMAL AND FUNGUS GALL-CAUSERS AND VASCULAR CRYPTOGAMS

HOMOPTERA (Aphides, Plant Lice)	**ACARI** (Mites)	**NEMATODA** (Eelworms)	**FUNGI** (Rust, Smut, etc.)
PSYLLIDAE : Aphalara Livia Psylla Psyllopsis Trichopsylla Trioza APHIDAE : Aphis Brachycolus Callipterus Chaitophorus Chermes Cryptosiphum Hyalopterus Macrosiphum Myzoxylus Myzus Nectaro-siphum Pemphigus Phorodon Phyllapis Phylloxera Rhopalo-siphum Schizoneura Siphocoryne Tetraneura COCCIDAE : Aspidiotus Asterodiaspis Asterole-canium Mytilaspis	TROMBIDIIDAE : Tarsonemus ERIOPHYIDAE : Epitrimerus Eriophyes Monochetus Phyllocoptes	ANGUILLULIDAE : Aphelenchus Heterodera Tylenchus	CHYTRIDIACEAE : Synchytrium PROTOMYCETEAE : Physoderma Protomyces PERONOSPOREAE : Cystopus EXOASCEAE : Exoascus Taphrina PHACIDIEAE : Ephelina Rhytisma SPHAERIOIDEAE : Coniothyrium HYPOCREACEAE : Epichloe USTILAGINEAE : Entyloma Schinzia Urocystis Ustilago UREDINEAE : Aecidium Coleosporium Gymno-sporangium Melampsora Puccinia Uromyces THELEPHOREAE : Exobasidium HYPHOMYCETES : Frankiella **MYCETOZOA** (Fungus Animals) Plasmodiophora Sorosphaera

CHAPTER II

GALLS CAUSED BY SAW-FLIES AND GALL-WASPS (HYMENOPTERA)

THE order Hymenoptera includes ants, bees, wasps, saw-flies, and ichneumon-flies, insects which easily take the first place as regards intelligence. It is divided into two very distinct sub-orders.

1. *Hymenoptera Sessiliventres*—Insects with the abdomen broad at the base, its first segment not completely amalgamated with the thorax.

2. *Hymenoptera Petioliventres* or *Petiolata*—The abdomen connected with what appears to be the thorax by a slender joint, the posterior part of the apparent thorax consisting of an abdominal segment.*

HYMENOPTERA SESSILIVENTRES

This suborder is divided into four families. The larvae of the majority usually destroy leaves after the manner of caterpillars, but in one family, the **Tenthredinidae** or saw-flies, the larvae of a few species live in galls.

Saw-flies are sluggish insects, chiefly occurring in May, June, and the early part of July. The second brood appears at the end of July and throughout August. The eggs are placed in the plant by a special apparatus, the ovipositor, or saw. This wonderful instrument has received the admiration of naturalists from the early days of entomology. Two centuries ago Réaumur described the saw, and also commented upon the placid disposition of saw-flies, suggest-

* Sharp, "Insects," in "Cambridge Natural History" vol. i., p. 503.

ing that it was given them to enable us easily to observe their marvellous operations. The sexes appear to be equal in only a few species. As a rule, the females are far more numerous than the males, and in some species males are unknown, parthenogenesis being frequent. For details concerning the habits of these most interesting insects the reader should consult Cameron's "British Phytophagous Hymenoptera," from which invaluable work I have taken the following paragraphs concerning the gall-causing species:

"So far as my observations go, I do not find any marked difference in the mode of oviposition of the gall and non-gall-making saw-flies. I have noticed with some of the latter incipient gall formation following oviposition. No doubt the distinction between the two lies in the fact that the former brings its eggs in contact with the cambium layer, the latter not."

"Unlike what happens with a cynips, the saw-fly gall is fully formed before the larva leaves the egg, so it is clear that the larva can have nothing to do in setting the gall growth in motion; while in the cynipidae no gall commences to form until such time as the larva quits the egg and commences to feed. The cynips larva, again, feeds on a particular layer of the gall—namely, that part which immediately surrounds itself, and which contains a large quantity of starchy matter. They feed up also very rapidly. The saw-fly larvae consume every part of the gall, which does not contain a special layer of nutriment, all the gall (except, perhaps, the outer skin) affording nourishment. They do not either feed up in a few days, like most cynipidae; they are not, indeed, any more rapid feeders than other larvae. In their general habits and mode of forming the cocoon they do not differ from their congeners which feed openly."

"The structure of the saw-fly galls is, except in the case of the woody galls of *Euura pentandrae*, very uniform. They are composed of irregular cells, the ordinary cellular struc-

ture of the plant profoundly modified. The cells forming the boundary are more regular than those near the centre; they are also smaller and more elongated, and this outer layer (which may be composed of one, two, or three rows of cells) contains few or no stomata."

The British gall-causing **Tenthredinidae** are comprised in the five genera *Blennocampa*, *Cryptocampus*, *Micronematus*, *Pontania*, and *Selandria*.

Blennocampa and *Micronematus* each contain but a single representative, and there are only two species of *Selandria*. *Blennocampa pusilla* attacks the leaves of wild and cultivated Roses, causing the margin to roll upwards. Theobald remarks concerning this gall:* "If one of the folds is opened we find inside one or more pale greyish-green or grey larvae. This folding of the leaves is mainly accomplished by the larvae, and as far as I can see it is done by them when immature. Cameron, however, says that they are aided by the incisions made by the females when they lay their eggs. The deformity produced in the leaves varies, but the rolls are always more or less cylindrical. When the leaf dies, the larvae move to another." *Micronematus abbreviatus* causes pustular growths on Pear leaves. *Selandria temporalis* causes the pinnules of the Bracken to swell, and *S. analis* gives rise to pustules on the lobes of the Male Fern. The genera *Cryptocampus* (*Euura*) and *Pontania* (*Nematus*) contain several species causing galls on Willows. For the purpose of assisting identification of the galls they may be arranged as follows:

Bud Galls

The greatly swollen bud does not open, and eventually dries up (*Cryptocampus saliceti* and *C. ater*).

Stem Galls

(*a*) Unilateral oblong swelling, 8 to 20 mm. long (*Cryptocampus ater*).

* "Enemies of the Rose," pp. 51, 52 (1910).

(*b*) Unilateral rounded swelling, attaining the size of a small nut (*Cryptocampus medullarius*).

Leaf Galls

(*a*) Petiole with fusiform swelling, 2 mm. in diameter; sometimes the base of the midrib is involved (*Cryptocampus venustus*).

(*b*) Margin loosely rolled inwards (*Pontania leucosticta, P. scotaspis, P. viminalis*).

(*c*) In the blade, showing on both surfaces—

- (i.) Elongated swelling (*Pontania femoralis*).
- (ii.) Smooth, bean-like, greenish or brown (*Pontania vesicator*).
- (iii.) Often corrugated, red, reniform (*Pontania proxima*).

(*d*) On the under surface of the blade—

- (i.) Glabrous and spherical (*Pontania salicis*).
- (ii.) Hairy and spherical (*Pontania pedunculi*).

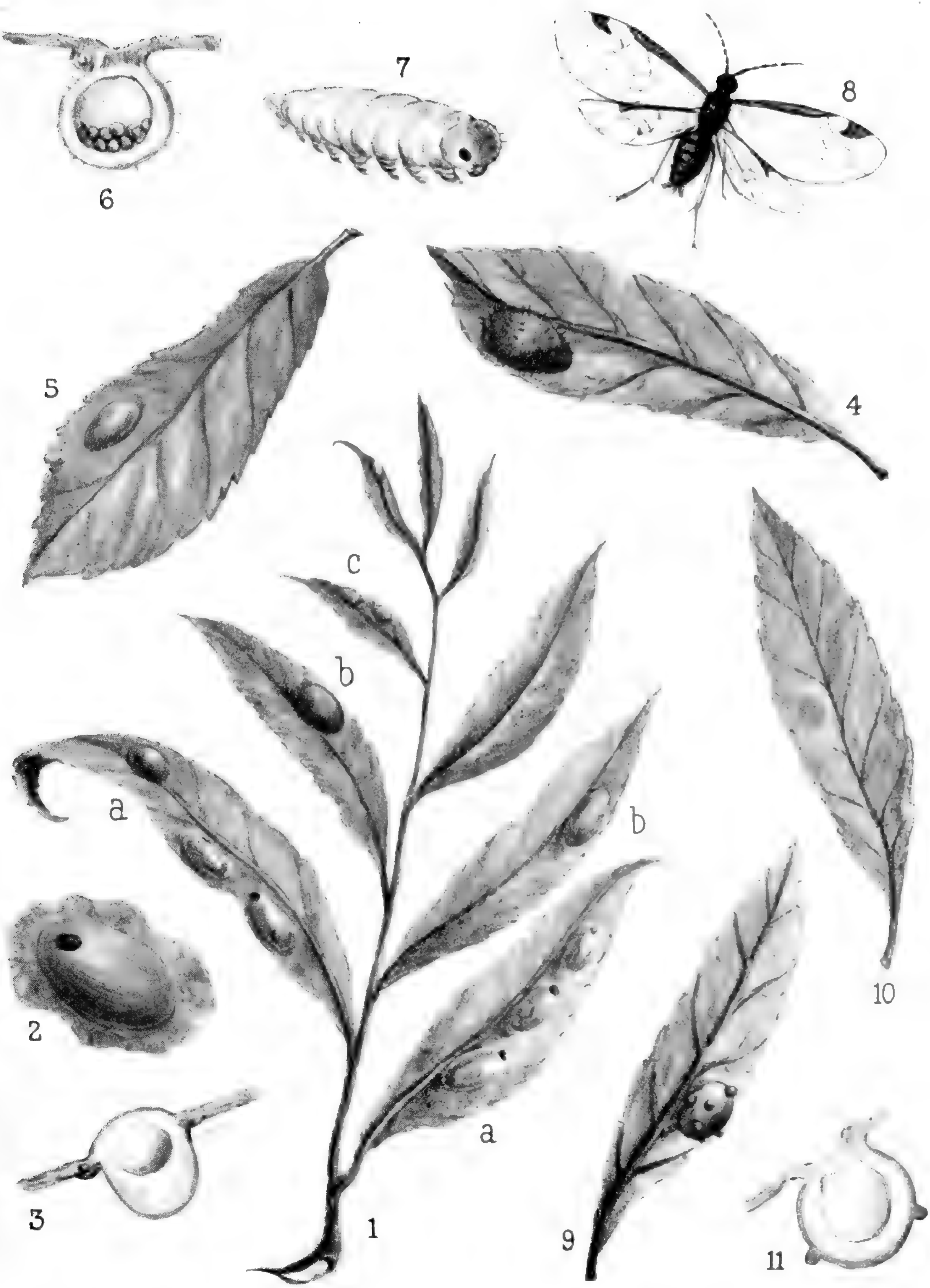
The best known of all the saw-fly galls on Willows is that caused by *Pontania proxima,* perhaps better known to British cecidologists under the name of *Nematus gallicola.* The leaf buds are attacked in May. The larva is at first white and transparent-looking, with a shining blackish head. It soon becomes green. At maturity the head has a greenish-white semicircle on the face. The pupa is white. These galls are often very abundant in June and July on many species of Willows. As a rule, there are two or three on a leaf (Plate II., 1), but occasionally there are as many as six. It is the exception to find a gall on the apical third of the leaf. In its early state the gall is almost solid, excepting a little space in the centre containing the egg. It usually appears almost equally on both surfaces of the leaf. The larva feeds around the interior, and by the time it is full fed the gall is a mere shell. The gall is yellowish-green at first; later it takes on a red tint, which is always more pronounced on the upper surface, and most vivid in leaves fully exposed to

sunlight. At an indefinite time in its growth the larva eats a round hole at one end of the gall, from which it ejects the frass. Occasionally it leaves its home, but never for long. The hole is always on the under side of the leaf, and almost invariably in that end of the gall which is towards the tip of the leaf. (See Fig. 1*a* in Plate II.) Fig. 2 depicts a magnified gall, and Fig. 3 a transverse section. It never opens directly upon the leaf surface, but is directed slightly upwards. Sometimes the egg is misplaced; the gall arises at the extreme edge of the leaf margin, and is abortive. The white cocoons are usually spun in the earth, but sometimes the larvae take advantage of the chinks in the bark of old Willows and pupate in them, occasionally many together. Cameron observes concerning these galls that "the cells adjacent to the epidermal layer are filled with chlorophyll granules, which give to this part a green, granular appearance. Near the centre the cells are paler, more irregular, contain apparently less chlorophyll and more intercellular spaces. When the galls are young the cells are not so irregular as they are later on—in fact, at first they do not differ much from the ordinary cells of the leaf."

Pontania salicis (it is burdened with many other names*) causes rounded glabrous galls on the leaves of *Salix purpurea* and other smooth-leaved Willows. The insect (magnified) is shown in Plate II., Fig. 8. Each gall is about 8 mm. in diameter, seated on the lower side of the leaf (Fig. 9), its presence being indicated on the upper surface by a rounded reddish-yellow spot (Fig. 10), not infrequently margined with lemon-yellow discoloration, especially towards the apex of the leaf. It is green at first, becoming yellow, and sometimes reddish, at maturity, and is joined to the leaf by a point. There is no hole for the expulsion of the frass. The surface is sometimes tuberculated. Fig. 11 is a magnified section of a gall.

The gall caused by *Pontania pedunculi* on the Goat Willow is of similar size, and also occurs on the under surface of

* E.g., *Nematus gallarum* and *N. salicis-cinereae.*



GALLS ON WILLOW LEAVES CAUSED BY SAW FLIES

the leaf, but may be distinguished at once by its velvety appearance, being covered with white hairs (Plate II., Fig. 4). Fig. 5 on the same plate shows the spot on the upper surface of the leaf; Fig. 6 a section showing the frass within; Fig. 7 is a magnified larva. Cameron considers this gall to be only that of *P. salicis* occurring on a hairy-leaved Willow. It must be remembered that the various species of saw-flies belonging to the genus *Pontania* (*Nematus*) are very much alike, differing but little in structural details, sculpture, pubescence, and coloration; consequently the arrangement and classification of them is a work of very great difficulty.

The gall caused by *Cryptocampus medullarius* in the young stems of the Bay-leaved Willow is the size and shape of a hazel-nut, and is remarkably woody compared with other saw-fly galls. Cameron remarks that, "besides the outer bark layer, there is next to it a wide layer of cellular tissue before the layer of woody fibre is reached. This, again, is succeeded by the spongy mass representing the medullary ray on which the larvae feed." Frequently through the fusion of adjacent galls a large plurilocular structure the size of a walnut is formed.

Pontania vacciniella attacks the leaves of the Cowberry, giving rise to oval bean-like galls, which are green at first, becoming brownish when old. In general structure and shape these galls do not differ from those of *P. salicis.*

HYMENOPTERA PETIOLIVENTRES

This suborder contains ten families; gall-causing insects occur in only two of them, the *Chalcididae* and the *Cynipidae.* Very few of the **Chalcididae** are gall-causers; the majority are either parasites on gall-causers or inquilines living in the galls on sufferance only. The members of the genus *Isosoma* are, however, truly phytophagous; the larvae of certain species live in the stalks of corn, and in some countries cause much damage to crops.

The only British gall-causing species are *Isosoma hyalipenne* and *I. depressum*. The former causes thickening of the haulm in the Sea Mat-grass; the internodes are shortened, the imbricated leaves are frequently not larger than the enlarged sheath, and the gall is a fusiform mass. There is an excellent illustration of it in Connold's "Vegetable Galls," Plate XLI. *Isosoma depressum* gives rise to irregular swellings of a yellowish-green hue on the Sheep's Fescue-grass.

The galls caused by the **Cynipidae** have received more attention than those of any other group of gall-causers, partly because of their frequency, but chiefly through the great interest attached to the life-histories of the insects. Theodore Hartig was the earliest scientific investigator of them; he was ably supported by Schenk, Mayr, and others, but it remained for Dr. Hermann Adler to discover the alternation of parthenogenesis and sexual reproduction in these insects. He published his discovery in 1877. His famous book on Alternating Generations was translated into French by Lichtenstein (1881), and into English by Dr. Charles Straton (1894). To the latter work and to Cameron's "British Phytophagous Hymenoptera" the reader is referred for detailed information concerning the gall-wasps.

The eggs are stalked. Adler suggested that the peduncle is used for respiration, for in those species in which the eggs are so placed that they cannot receive oxygen from the plant the peduncle is very long; in those which place their eggs in leaves it is short. As a rule, the peduncle is long in winter generations and short in those of spring. Some species deposit a large number of eggs; the ovaries may contain more than 600. It is obvious that oviposition is easiest in those species which deposit their eggs in leaves. Cameron observed that the egg swells after introduction into the plant.

The larva is footless, white, and of sluggish habits. In the spring brood the larval life is short; in the winter

brood it may be greatly prolonged, the larva remaining unchanged for several years. The larvae of *Callirhytis glandium*, which galls acorns, may delay metamorphosis for three years. Mr. Fitch collected some galls in 1878 in which the larvae were still living in 1881. The pupa is white and fleshy.

The imagines (perfect insects) are sluggish and of uninteresting habits. The sexes are much alike; there is no marked difference in coloration; the males are a little shorter and have longer and thinner antennae. The sexual and agamic females show many points of difference. The agamic are usually larger, differently coloured, and the ovipositor differs both in form and size.

In some species the imagines are so much alike that the only certain test of identification is the gall from which they have emerged.

It is now generally agreed that cynipidous galls arise from the irritation of the meristematic tissue by the movements of the larva. The egg alone does not give rise to gall growth, for in some cases it is deposited weeks before the gall begins to form. Cameron* concluded "(1) that there is no evidence that the venom has anything to do with the origin of the gall—on the other hand, there is every reason to believe that its use is to close the wound; and (2) that as observation shows that the mechanical irritation produced by the birth and growth of the larva is the primary factor in gall genesis, we may fairly conclude that the theory of mechanical irritation is more in consonance with observed facts than the infection one." There is no permanent opening in the galls of the *Cynipidae;* the larvae are immersed in the substance of the gall, and pupate in it; the imagines bore their way out.

The galls may be only slightly attached to the plant, or more or less embedded in the tissue. If there is only one cell within, the gall is styled "monothalamous" or "unilocular"; when many cells are present it is termed "polythalamous" or

* "British Phytophagous Hymenoptera," vol. iv., pp. 23, 24.

"plurilocular." The presence of inquilines may convert a truly monothalamous gall into an apparently polythalamous one. It should be noted that these galls may contain, in addition to the true gall-flies or Psenides, insects whose parents effected a burglarious entrance, and deposited their eggs within the young gall. These are known as guest-flies and parasites.

The guest-flies are of two kinds:

1. *Inquilines.*—These are more or less nearly related to the rightful occupants of the gall. The larvae live in the gall substance, and usually secure the maximum food-supply by killing off the owners.

2. *Commensals.*—These feed on the gall substance, thus depriving the legitimate occupants of a certain amount of food-supply, but do not, as a rule, commit murder.

The parasites devour the larvae and pupae not only of the freeholders, but also of both classes of burglars. They belong chiefly to the family *Chalcididae*, small hymenoptera with gorgeous raiment, brilliant metallic blues and greens being the predominating colours.

It is obvious that the investigation of the contents of a cynipidous gall is one of considerable difficulty. Dr. Sharp remarks:* "It is clear that, as we cannot ascertain what is inside a gall without opening it, and thereby killing the tenants, it is a most difficult matter to identify the larvae. The only safe method is that of observation of the act of oviposition; this may be supplemented by rearing the flies from galls, so as to ascertain what variety of flies are associated with each kind of gall. The last point has been well attended to; but the number of cases in which oviposition of inquiline gall-flies in the galls formed by the Psenides has been ascertained by direct observation is still very small; they are, however, sufficient to show that the inquilines deposit their eggs only after the galls are formed."

A surprising number of insects may be bred from the larger Oak galls; it is on record that thirty different species,

* "Insects," in "Cambridge Natural History," vol. i., p. 532.

representing nearly all the orders, have been obtained from a single gall!

The cynipidous galls may be conveniently considered under two headings.

I. GALLS ON PLANTS OTHER THAN OAK

The causers of these belong to five genera—*Aulacidea*, *Aulax*, *Diastrophus*, and *Rhodites*.

Aulacidea hieracii attacks the stem and root of the Common Hawkweed, Yellow Toadflax, and Couch-grass; the larvae give rise to longitudinal or rounded swellings. In the last named the distortion is usually slight. Several larvae occupy a cell. Galls caused by certain species of *Aulax* are very familiar objects. Three of them are shown in our plates.

The larvae of *Aulax hypochaeridis* give rise to elongated and fusiform (rarely rounded) swellings on the stem of the Long-rooted Cat's-ear (Plate XXIX., Fig. 1). The petioles are sometimes attacked, and not infrequently the whole plant is deformed. The galled part is yellowish-green or brown at maturity. The gall is plurilocular; each cell contains a yellowish-white larva. Fig. 3 depicts a section, natural size. The larvae pupate in the gall, and the wasps appear in spring. Plate XXIX., Fig. 4, shows an imago, magnified.

Equally common galls arise on the leaves and stems of the Ground Ivy (Plate XXIX., Fig. 5) when attacked by *Aulax glechomae*. They vary in size from a pea to a large marble, are yellowish-green at first, becoming suffused with red or purple at maturity, and are covered with long white hairs. These galls are usually solitary; sometimes two or three coalesce; a section of such is shown at Fig. 7. The larva (Fig. 8) pupates in the gall, the imago (Fig. 9) appearing the following April. In the growing state the gall is soft and sappy; at maturity the interior is dry and fibrous, the larva being encysted in a remarkably hard inner gall. The larvae are attacked by several parasites. Réaumur * remarked that these galls were eaten by the

* "Mém.," iii., p. 416.

French peasants in his time, "Dans certaines années où elle en étoit chargée, les paysans se font avisés des manger de ces pommes du lierre terrestre, et les ont trouvées bonnes. J'en ai goûté, leur faveur aromatique m'a paru tenir beaucoup de celle que l'ordorat fait imaginer que la plante doit avoir; au reste, il faut cuellir de ces galles de bonne heure, pour ne pas les avoir trop sèches et trop filamenteuses. Je ne scais pour tant si elle pourront jamais parvenir à être mises au rang des bons fruits." Our illustrations of this gall are from specimens gathered on Brean Down, near Weston-super-Mare, where I observed them in great numbers in June, 1910. Many of the afflicted plants bore flowers, and in the majority the leaves alone were attacked. The usual colour of galls growing in shade was a yellowish-green; those exposed to the sun were vividly tinted.

Aulax papaveris attacks the Common and Smooth-headed Poppies, causing the capsules to become more or less swollen and deformed. (See Plate XXIV., which also shows normal capsules.) The larval cells are often numerous, ranging from ten to sixty in a capsule. Sometimes the capsules are very slightly swollen, and the presence of the parasite may be quite unsuspected by the casual observer. Cameron considers the *Aulax minor* of Hartig to be only a variety of *A. papaveris*. Houard, however, gives it specific rank. The galls differ in certain particulars. In those induced by *A. papaveris* the larval cells are irregularly distributed in the capsule, and the septa are obliterated. In those of *A. minor* the septa remain intact, the larval cells are, as a rule, completely separated, and the capsules are very seldom enlarged.

Diastrophus rubi causes irregular spindle-shaped galls on the stems of various brambles. These galls are green at first, then reddish, and are brown at maturity. They range from 2 to 8 inches in length, and the stem is usually curved at the point of attack, not infrequently in the form of the letter **S**. They sometimes bear several small spines, occasionally a few large ones only. The surface is always

mammillated, each protuberance indicating the position of a larval chamber.

Rose leaves attacked by *Rhodites* produce some of the most attractive of British galls. Three of them are shown in Plate III., the frontispiece. Fig. 1 is the well-known and universally admired gall popularly known as "Robin's Pincushion," "Moss Gall," or "Bedeguar Gall." The curious word "Bedeguar" is said either to be derived from the Persian and Arabic *bādāwar*, "wind-brought," or to be a compound of the Persian *bād*, "wind," and the Arabic *ward*, "rose." When occurring on the Sweet-Briar this gall is sometimes spoken of as the "Sweet-Briar Sponge." It arises from the attack of a leaf bud in spring by the female *Rhodites rosae*. According to Pazlavsky, she pricks the bud carefully in three distinct places, causing the three rudimentary leaves to develop, not as normal leaves, but into the curious production so well known to botanists. The "moss" is leaf with but little parenchyma between the fibro-vascular bundles. The gall is usually large, but occasionally, through an error of judgment on the part of the wasp, or more probably through interruption during the pricking operation, an abortive gall arises, a much smaller structure seated on a developed leaf. This gall is at its best in the latter part of July and early in August. It occurs chiefly on small and weakly bushes. As the male is rare, *Rhodites rosae* is doubtless a parthenogenetic species. The galls were used medicinally in olden times, and less than a century ago the farmers of the Harrogate district used them for an infusion to cure diarrhoea in cows. Old Réaumur said that the smell of Bedeguar galls is attractive to cats.

Fig. 4 on the same plate shows the graceful little spiny pea galls which arise from the presence of the larvae of *Rhodites rosarum* in the leaflets of the Dog Rose. Fig. 5 shows a detached gall, actual size, and Fig. 6 the magnified insect. The male was unknown to Cameron. This gall appears in July, and falls to the ground at maturity. It

bears from two to five sharply pointed spines. Fig. 7 depicts the young state of the smooth pea gall caused by *Rhodites eglanteriae.* This gall is frequent in August and September. It is usually situated on the upper surface of a leaflet, occasionally it appears on a sepal or on the stem. It becomes brown or reddish towards maturity. Fig. 8 shows a section of a gall with the larval cavity in the centre, and cells of inquilines around it. Fig. 9 is an enlarged view of the larva; Fig. 10 the female insect, magnified. The male is very similar, but the abdomen is darker.

The little Burnet-leaved Rose is frequently attacked by *Rhodites spinosissima.* The galls occur on the stem, leaves, petioles, and flower buds. They are green at first, assuming a pretty red tint at maturity. Isolated ones are either ovoid or reniform; they frequently occur in conglomerated hard woody masses of various shapes. The male of *R. spinosissima* is rare. Cameron figures the female, remarking that he had never seen her consort. Many inquilines and parasites have been bred from all the *Rhodites* galls.

II. GALLS ON THE OAK

The great point of interest in connexion with many of the **Cynipidae** of the Oak is the alternation of parthenogenetic and sexual reproduction.

Parthenogenesis, as defined by Von Siebold in 1856, is the power possessed by certain female animals of producing offspring without sexual union with a male. Bonnet, as early as 1745, observed the production throughout the summer of numerous generations of female yet fertile Aphides. Hartig carried out extensive breeding experiments with Oak gall-wasps about 1840, and demonstrated the existence of numerous species in which only females exist. Bassett, in 1873, suspected that the parthenogenetic generation of these is followed by a sexual one. Two years later, Dr. Adler, who was quite unaware of Bassett's work and surmises, solved the problem by careful experiments with wasps of

the genus *Neuroterus*, arriving at the surprising result that from the eggs laid by these, wasps were produced which were so unlike their parents that they had been placed in a separate genus, *Spathegaster*. He published this fact in 1877, and afterwards extended his observations to the majority of the Oak gall-flies of North Germany, showing that the phenomenon is observable in many species.

Particulars concerning the methods of investigation employed by Dr. Adler in the course of his researches may be consulted in the first chapter of "Alternating Generations." Oak saplings were used, either grown in pots or obtained from nurserymen; those from four to six years old proved to be the most convenient size. It was found that gauze covers with a glass top were better than ordinary bell-glass protectors, the absence of free ventilation causing the latter quickly to become dimmed with moisture. It was easy to make experiments with species which prick the leaves or bark, but some difficulty was experienced with those which only prick flower-buds, as the majority of four to six year saplings do not produce catkins. Consequently the experiments were made in the open air on full-grown trees, using cubes of wire covered with muslin, and tied round the branch. "It is an essential that a sapling about to be used in an experiment should have its buds well developed, as these are always preferred by the flies."

The following tables concern the known British species of gall-causing **Cynipidae**. If the second is examined in connexion with the footnote, it will be observed (omitting *Cynips Kollari* and *C. calicis* for obvious reasons) that there are six species in which the agamous generation alone is known, and six in which it is unknown. It is probable that future research will show there are but six species, each with an alternating generation.

CYNIPIDAE WHICH CAUSE GALLS ON "QUERCUS ROBUR" IN BRITAIN

I. SPECIES WITH ALTERNATING GENERATIONS

Sexual Generation.	Name of the Gall.	Its Position.	Agamous Generation.	Name of the Gall.	Its Position.
Andricus cirratus	Tufted Gall	Catkin	Andricus callidoma	Stalked Spindle Gall	Bud
,, curvator	Curved Twig Gall	Leaf	,, collaris	Collared Bud Gall	Bud
,, gemmatus	Bud Gall	Bud	,, corticis	Bark Gall	Trunk
,, inflator	Twig Gall	Bud	,, globuli	Globular Gall	Bud
,, trilineatus	Knot Gall	Twig	,, radicis	Truffle Gall	Trunk
,, nudus	Bald Seed Gall	Catkin	,, malpighi	Malpighi's Gall	Bud
,, pilosus	Hairy Catkin Gall	Catkin	,, fecundator	Artichoke Gall	Bud
,, ramuli	Cotton Gall	Catkin	,, autumnalis	Autumn Gall	Bud
,, testaceipes	Leaf Vein Gall	Leaf	,, Sieboldi	Red Barnacle Gall	Trunk
Biorrhiza pallida	Oak Apple	Bud	Biorrhiza aptera	Root Gall	Root
Trigonaspis megaptera	Pink Wax Gall	Trunk	Trigonaspis renum	Kidney Gall	Leaf
Neuroterus albipes	Schenck's Gall	Leaf	Neuroterus laeviusculus	Smooth Spangle Gall	Leaf
,, baccarum	Red Currant Gall	Catkin	,, lenticularis	Common Spangle Gall	Leaf
,, tricolor	Hairy Pea Gall	Leaf	,, fumipennis	Cupped Spangle Gall	Leaf
,, vesicator	Blister Gall	Leaf	,, numismatis	Silk-Button Spangle Gall	Leaf
Dryophanta verrucosa	Red Wart Gall	Bud	Dryophanta divisa	Scarlet Pea Gall	Leaf
,, similis	Green Velvet Bud Gall	Bud	,, longiventris	Striped Pea Gall	Leaf
,, Taschenbergi	Purple Velvet Bud Gall	Bud on trunk	,, folii	Cherry Gall	Leaf

II. SPECIES OF WHICH THE ALTERNATE GENERATION IS UNKNOWN, OR IMPERFECTLY KNOWN

Sexual Generation.	Name of the Gall.	Its Position	Agamous Generation.	Name of the Gall.	Its Position.
Neuroterus Aprilinus	April Bud Gall	Bud	—	—	—
Andricus amenti	Lesser Hairy Catkin Gall	Catkin	—	—	—
,, clementinae	Pointed Bud Gall	Bud	—		—
,, glandulae	Radiate-haired Bud Gall	Bud	—		—
,, lucidus	Hedgehog Gall	Cupule	—	—	—
,, solitarius	Red-haired Bud Gall	Bud	—	—	—
—	—	—	Andricus ostreus	Oyster Gall	Leaf
—	—	—	,, quadrilineatus	Furrowed Catkin Gall	Catkin
—	—	—	,, marginalis	Marginal Gall	Leaf
—	—	—	,, albopunctatus	Spotted Bud Gall	Bud
—	—	—	,, seminationis	Barleycorn Gall	Catkin
—	—	—	Dryophanta agama	Yellow Pea Gall	Leaf
—	—	—	,, disticha	Double-celled Pea Gall	Leaf
—	—	—	Callirhytis glandium	Acorn Gall	Acorn
—	—	—	Cynips Kollari	Marble Gall	Bud
—	—	—	,, calicis	Knopper Gall	Cupule

Notes

According to Adler, *Andricus ostreus* is the agamous generation of *Neuroterus Aprilinus*.

Cameron considers *Andricus marginalis* to be *A. quadrilineatus* from leaf galls, and *A. albopunctatus* to be identical with *A. quadrilineatus*.

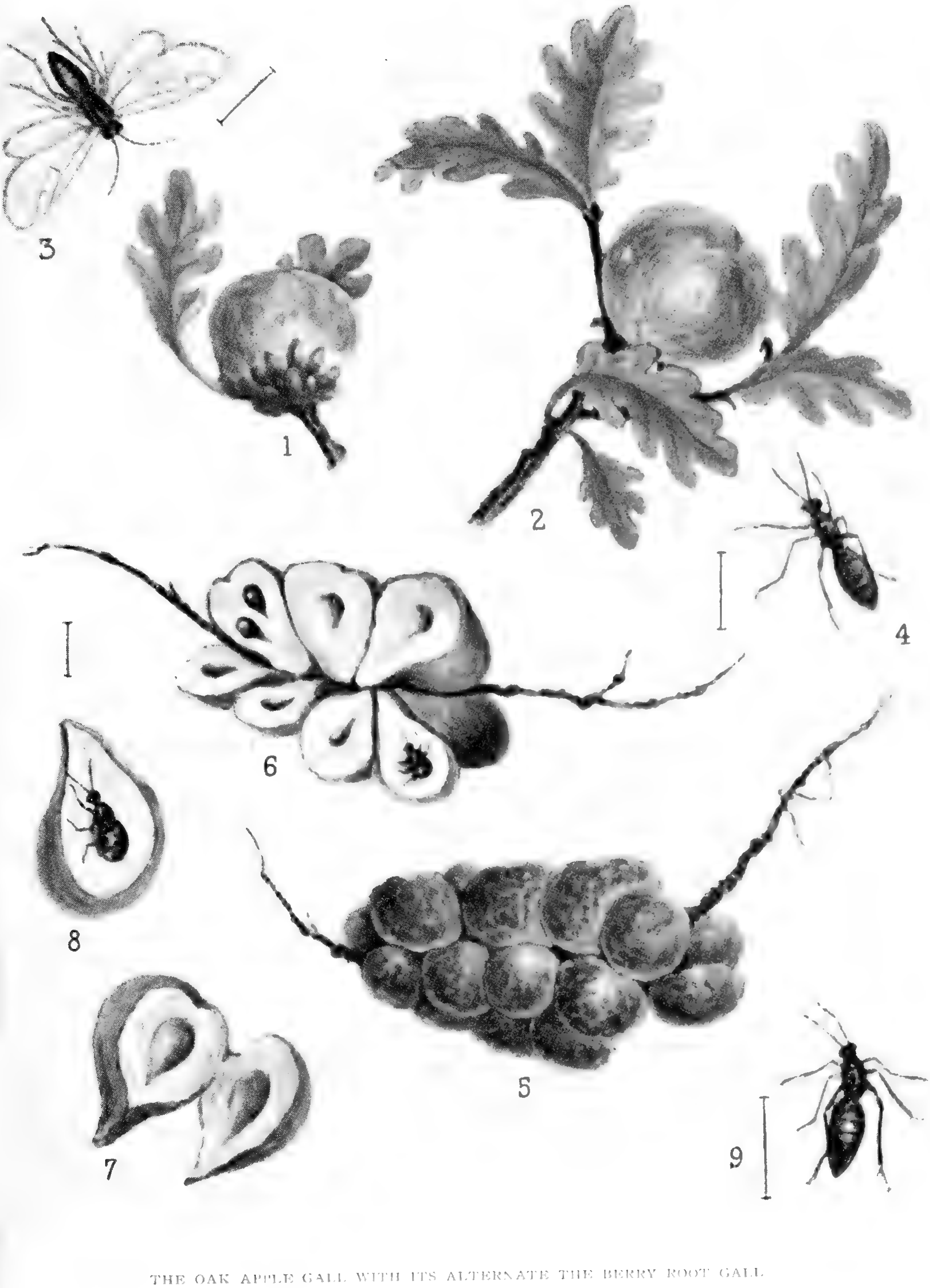
Beyerinck asserts that *Cynips Kollari* is the agamous generation of *Andricus circulans* from the Turkey Oak Bud Gall.

Cynips calicis is recorded from the Channel Islands only.

Some of the galls caused by species in which the alternation of generations occurs are delineated in Plates IV., V., and XXII.

The first of these concerns the familiar "Oak-apple." If the reader visits a coppice in January, and carefully removes the earth from around some of the roots of an Oak, he may find upon them hard, brownish, spherical excrescences, ranging up to $\frac{1}{2}$ inch in diameter. All Oaks do not bear them, and perhaps considerable patience will have to be exercised before any are found. These galls may occur either singly or in large masses as seen in Plate IV., Fig. 5, but are never truly coalescent. If one of them is cut open, a yellowish-brown "fly," about 6 mm. long, will crawl out (Fig. 8). "Fly" is the term in general use, but it is not correct; the insect is a wasp, not a fly. Figs. 7 and 9 show respectively the gall and the insect, the latter magnified.

This wasp is the *Biorrhiza aptera*. It is always a female and always wingless. Her lot in life is not cast in easy lines. First of all she has to bore through the hard wall of the gall, next she has to push her way up through the earth and gain the trunk. Up this she crawls, a journey beset with a thousand perils. It is winter-time, and, with diminished food-supply, trunk-haunting birds, such as tits, nuthatches, and creepers, are maintaining a very vigorous search for insects of all kinds. Her quest is suitable terminal buds, in which she bores canals and deposits her eggs. Adler has given a vivid description of these boring operations, which differ from those of other gall-wasps. The necessary canals are first bored or pricked in the bud; the eggs are pushed in afterwards. They are laid, not singly, but in hundreds, and their deposition requires time. "On January 27, 1878," wrote Dr. Adler (I am quoting from Dr. Straton's well-known translation), "a fly was put upon a little oak, and soon began to prick a bud; when it had finished the first bud, it went on, without interruption, to another, and was altogether eighty-seven hours busily employed in laying its eggs. In these two buds I counted



THE OAK APPLE GALL WITH ITS ALTERNATE THE BERRY ROOT GALL

582 eggs." The "fly" often attacks the buds so fiercely that the tissues are destroyed and no gall results; but where her zeal has been tempered with discretion the bud begins to swell about the beginning of May. Gall formation proceeds rapidly, and by the end of the month the "Oak-apple" has arrived at maturity (Plate IV., Fig. 1). It is usually solitary, but sometimes three or four may be found together. It is greenish-yellow at first, and soft and sappy, becoming harder and tinted rose colour at maturity. The larval cavities are numerous, and many of them contain parasites, this gall being exceptionally prone to attack by many species. The wasps (*Biorrhiza pallida*, also known as *Teras terminalis*) emerge in July. Both sexes are present; the male is winged (Fig. 3), the female wingless (Fig. 4), or provided with rudimentary wings. She much resembles her mother, but is smaller. Adler proved by experiment that she crawls down the trunk and pierces the roots. The presence of the larvae therein gives rise to the root-galls already described, and so the generations are repeated. Some females appear to inherit the instincts of the mother instead of the grandmother, pricking leaves and buds instead of roots; the galls that result are, however, always abortive. The root-gall, it may be observed, yields no inquilines, and but one parasite.

An Oak sprig bearing an "apple" was worn on May 29 to commemorate the return of Charles II. to England on that date (his birthday), and his escape after the Battle of Worcester. The custom still survives in some parts of the kingdom. Excepting in minor details, the life-history of the "Oak-apple" gall-wasp is the same as that of all in which the regular alternation of generations occurs. The larvae of the parthenogenetic winter brood develop in more or less hard galls of slow growth (subterranean in two species); the larvae of the sexual summer generation develop in soft sappy galls of rapid growth. The soft galls are produced in spring, when the supply of sap is abundant; the harder galls arise in autumn, when there is diminished

sap-supply, and these provide the requisite shield for the helpless larvae during the long months of winter.

Oak galls are remarkably sporadic in their times of appearance. A gall may be very abundant one year, very scarce the next, and perhaps for many successive years. Of course, infrequency of the galls does not necessarily imply scarcity of the insects: they may have been as numerous as ever. In the case of spring forms, atmospheric conditions may retard the rise of the sap, and the larvae perish. Adler states that he was compelled to attribute to meteorological conditions a most important influence over the development of the egg. In 1904 the currant gall was extraordinarily abundant around Haslemere. I then recorded in my notebook that "on nearly every Oak tree the male catkins are festooned with them, but here and there a tree may be found which, to all appearances, has entirely escaped attack. We always find exceptionally fine galls on *Q. sessiliflora*. The catkins which do not bear galls wither up and drop very quickly; the stalk of a galled one maintains its vitality for a considerable time." The currant gall is well named. It appears in the latter part of May and early in June on the staminate flowers, and at maturity exactly resembles a red currant (Plate V., Fig. 1).

Fig. 2 on Plate V. depicts a magnified section with the larval cavity. These galls grow with great rapidity. The wasps develop with equal rapidity, and by the end of June the majority will have left the galls. The wasp known as *Neuroterus baccarum* (Fig. 3) is about 4 mm. long; the male has fifteen joints to each antenna, his partner one less. The galls also appear on the leaves, in which position they are larger, and green, never red. Barrett noted that the Tortrix *Sciaphila communana* lives in these galls. Many parasites have been bred from them. Rolfe found currant galls on nine species of Oak in the Quercetum at Kew. The female *N. baccarum* attacks the under surface of young Oak leaves, causing the well-known common spangle gall (Plate V., Fig. 4, *a*, *a*) to appear in July. These galls are

OAK SPANGLE GALLS WITH THEIR ALTERNATE FORMS

reddish at first; Fig. 6 gives a magnified view of a growing one, and Fig. 5 a section of an adult. They arrive at maturity (Fig. 4, seven galls opposite to letter *a*) in September, become detached from the withering leaf, and fall to the ground. After falling, the gall loses its umbonate appearance and becomes round; the larva continues to grow in it, pupates in March, and the wasp, *Neuroterus lenticularis* (Fig. 7), appears in April, a minute insect about 2·5 or 3 mm. long. This gall was as abundant in 1904 as the alternate form. On three leaves from a sapling Oak at Haslemere I counted 286, 379, and 326 galls, an average of 330 for each leaf.

Fig. 8, *d*, on Plate V., depicts the oval yellowish gall of *Neuroterus albipes.* It appears in May; the wasp emerges and attacks the leaves in June, and the smooth spangle gall appears in July. This gall is cup-shaped (Plate V. 9, *f*; a magnified section is shown at Fig. 10). It matures in September, falls to the ground, and the wasp, *Neuroterus laeviusculus*, appears the following March.

Fig. 8, *c*, on the same plate, shows two blister galls caused by the presence of the larvae of *Neuroterus vesicator.* These galls are pale green, and more or less rounded, projecting slightly from both surfaces of the leaf. On the superior surface there is a small raised point from which striae radiate to the margin (see magnified section, Fig. 11). They appear in May, and the wasps emerge in June, to prick the under surface of leaves and give rise to the beautiful little silk-button spangle galls (Plate V., Fig. 9, *e*; Fig. 12 is a magnified section, and Fig. 13 an enlarged view of a gall), from which *Neuroterus numismatis* emerge in April, and attack the leaf buds, giving rise to blister galls. The silk-button gall was remarkably abundant in 1904. Three leaves bore 1,741 galls, in the proportion of 502, 558, and 681. To appreciate fully the beauty of this gall it should be examined with a binocular microscope, using a 2-inch objective.

Fig. 14 on Plate V. depicts two of the hairy Pea galls

caused by the presence of the larvae of *Neuroterus tricolor*. These galls are whitish, and covered with erect white hairs. They appear in June, and mature in July. The wasps emerge towards the end of that month, and prick the under surface of the leaf. The cupped spangle galls result (Fig. 4, *b*; a magnified section is seen at Fig. 15). This gall is sometimes confused with that of *N. laeviusculus*, but there should be no difficulty in diagnosis if the sections are carefully compared. The wasps which emerge are known as *Neuroterus fumipennis*. Adler observes: "They are very active little flies . . . continually running from side to side and flying from one shoot to another."

There is an attractive-looking gall which sometimes resembles a large ripe cherry, which appears in September on the under surface of Oak leaves (Plate XXII., Fig. 6). It is noteworthy that in 1910, which was not a favourable year for Oak galls, it was very abundant in many districts; I noted it in enormous numbers on fallen leaves in Woolmer Forest. Its vivid tints are chiefly seen in bright summers; in the dismal summer of 1910 the great majority were yellowish-green. The colour is retained for a considerable time after the leaf has fallen and withered (Fig. 7). The wasp that emerges from it is the *Dryophanta** *folii* (Fig. 8). It usually bores the canal for emergence some time before leaving its home, the outer skin of the gall remaining unbroken. It oviposits in the adventitious buds at the base of the trunk. According to Adler, only one egg is laid in each bud. The gall which results is small, 2 to 3 mm. long, of a beautiful dark violet colour, with a velvety appearance (Fig. 5). These galls appear about the end of April, and the wasps emerge towards the end of May. They are the *Dryophanta Taschenbergi*, and were at one time placed in the genus *Spathegaster*.

Fig. 3 on the same plate shows the under surface of an Oak leaf with two striped pea galls and three common spangle galls. The striped pea gall is easily identified by

* Dryophanta = Diplolepis of modern German authorities.

the white and red stripes; the surface is usually granular. It appears early in August, and is mature in October. The majority of these galls are deformed, stunted, and infested with parasites. The wasp (*Dryophanta longiventris*) emerges in the beginning of December. Fig. 4 depicts a magnified section of a gall with a wasp upon it. It seeks the adventitious buds. The galls which result from the presence of its larvae therein much resemble those of *D. Taschenbergi*, but are more pointed, and greenish-grey, never violet. The surface also is more pubescent than that of the purple velvet bud gall, being covered with long white hairs. This gall is usually found on adventitious buds low down on old trunks. It appears in April; the wasp (*Dryophanta similis*) emerges in the middle of May. Figs. 1 and 2 show galls natural size and magnified. Adler thought that *D. folii* and *D. longiventris* sought the adventitious buds at the foot of the tree because these are the first to be reached in spring by the rising sap, it being an advantage for the summer generation to leave early, before many parasites are abroad.

Five scarlet pea galls are shown at Fig. 12 on Plate XXII. These galls are the size of small peas, bright red at first, becoming brown at maturity. They appear about the end of June, and mature in October. They are seldom solitary, and always grow from the larger veins. The wasp (*Dryophanta divisa*) emerges in the latter part of November, and pricks the large terminal buds and rudimentary leaves. The red wart gall which results appears in May. I have not found it; the illustrations are copied from Adler. Fig. 9 shows a gall on a leaf and another on a petiole; Fig. 10 one on a leaf; Fig. 11 one growing through the top of a bud. Adler observes that the gall matures in the end of May, and the wasp (*Dryophanta verrucosa*) appears about that time or early in June.

On Plate I. we have depicted the "oyster" gall, which, as already remarked (p. 5), was very abundant during the summer of 1911. Magnified illustrations of it are

shown in Fig. 4. The brown flaps of epidermis that remain after it has fallen away are depicted in Fig. 5. These are supposed to resemble the valves of an oyster-shell—hence the popular name, which is not very appropriate. The falling of the galls caused a constant pattering noise in the woods throughout August and September, resembling that of rain drops. They fell in such numbers that on a square inch of road beneath an Oak on August 21 I counted thirteen of these galls. The wasp that emerges from the "oyster" gall is the *Andricus ostreus*. According to Adler, the sexual form is *Neuroterus Aprilinus*, but Mayr holds other views, and Beyerinck claims to have bred *N. Aprilinus* from

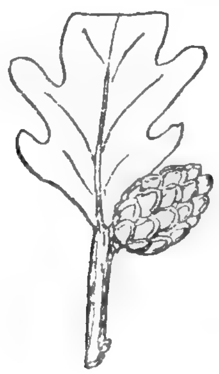


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FIG. 2—AXILLARY BUD OF THE COMMON OAK WITH GALL CAUSED BY THE PRESENCE OF THE LARVA OF *Andricus fecundator*. (1/2.)
FIG. 3—STAMINATE FLOWERS WITH GALLS RESULTING FROM THE PRESENCE OF THE LARVAE OF *Andricus pilosus*. (3/1.)

galls caused by the presence of the larvae of *Andricus solitarius*.

In some instances the galls of one generation are rarely seen, whilst those of the alternate one are very common. In the majority the apparently rare galls are the little spring forms on buds and staminate flowers, and it may be concluded that they escape observation through their minuteness, and the fact that they are usually situated on the higher branches.

The hairy catkin gall and its alternate, the well-known artichoke gall, illustrate this. The former is said to be rare in Britain. It appears on the staminate flowers in

May. It is greenish at first, becoming brown at maturity, and is covered with erect whitish hairs. It much resembles the gall of *Andricus amenti* (whose agamic generation is unknown), but is larger, stouter, not so pointed, and has longer hair.

Andricus pilosus appears in the middle of June. The female attacks the axillary buds, giving rise to the artichoke or hop gall. This gall occurs chiefly on young Oaks, often in large numbers on saplings. The scales of the leaf bud become greatly hypertrophied, and the true gall lies in their midst. It is small, pear-shaped, green at first, brown at maturity, becoming hard and woody. In its


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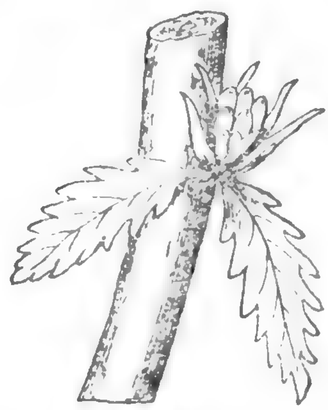
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FIG. 4—GALLS ON BUDS OF THE COMMON OAK CAUSED BY THE PRESENCE OF THE LARVAE OF *Cynips Kollari*. (1/2.)
FIG. 5—GALLS CAUSED BY THE PRESENCE OF THE LARVAE OF *Andricus circulans* IN A TURKEY OAK BUD. (2/1.)

early state it is joined to the bud, later it becomes detached and falls to the ground. The wasp (*Andricus fecundator*) may emerge in spring, but in many cases the larva lives within its wooden prison for three, or even four, years before metamorphosis takes place. Some, for unexplained reasons, never change. The inquilines and parasites are not numerous; lists have been given by Cameron and others. The moth *Carpocapsa juliana* is found commonly in these galls.

The very familiar marble gall is situated on a terminal or lateral bud, and is about the size of a marble when full grown. It is yellowish at first, becoming brown at

maturity, in September usually. These galls are commonly gregarious, and not infrequently coalescent. The larval cavity is central; twin galls often have but one larval chamber. Parasites are numerous. The wasp (*Cynips Kollari*) emerges in September or October by a circular hole.

According to Beyerinck, the bud gall of the Turkey Oak results from the attack of this wasp. He saw *Cynips Kollari* pierce the buds in October, 1901, and the following April the galls matured. The wasps therefrom are the *Andricus circulans*. I have not succeeded in finding the Turkey Oak bud gall, though I have repeatedly searched for it in many districts. The illustration of it is drawn up from Cameron's figure, and the following notes are taken from his "British Phytophagous Hymenoptera" (vol. iv., pp. 105, 106): "The galls are found in the axillary leaf buds of *Quercus cerris* gregariously, one, four, or eight being found in a bud, and they may be packed so closely together that they become compressed and flattened. They are glabrous, well hid in the bud, in colour varying from brownish-yellow to bright red, thin-walled; in shape an elongate ovoid, and in length 2 to 5 mm.

"Miss Ormerod found at Kew some galls which, although not quite typical, yet still may safely be referable to *A. circulans*. My figure is taken from a specimen I had from Professor Mayr. According to the latter authority, the normal time for the flies issuing from the galls is towards the middle of April."

Beyerinck did not succeed in getting *Andricus circulans* to oviposit in *Quercus robur*. The fact that the Turkey Oak bud gall has not been observed in this country since Miss Ormerod obtained specimens at Kew in 1878 makes it very desirable that Beyerinck's experiments be carefully repeated. It seems unlikely that the alternate generation of *Cynips Kollari* is to be found on *Quercus cerris*, an Oak which is usually avoided by the gall-wasps which frequent *Quercus robur*.

It may be of interest to note, in reference to the marble

gall, that it was probably unknown in this country prior to 1830, about which time it seems to have been brought to Exmouth in connexion with the cloth manufacture at Exeter, Tiverton, and other places in the West of England, but whether for dyeing purposes is not quite certain. The insects escaping, the gall gradually appeared throughout Devon, spreading east and west, and causing much consternation at the time. A lot of nonsense was spoken and written about the destruction of the Oak, and in 1852 the labourers were exhorted to "rally round the pig," it being maintained that the acorn crop was being destroyed and the farmers ruined. The gall is now abundant over the whole of Britain, and our oaks are none the worse. A most interesting account of *Cynips Kollari* and its gall, with lists of parasites, is given by Dr. Straton in Appendix I. to "Alternating Generations" (pp. 163-167).

Rolfe, in his notes on Oak galls occurring in the Quercetum at Kew (1881), enumerates some of the abovementioned galls as occurring on several varieties of *Quercus pedunculata*, also on *Quercus Turneri* (= *Q. pedunculata* × *Q. ilex*), *Quercus infectoria*, and others. The same observer, with Miss Ormerod, noted the galls of *Callirhytis glandium* on *Quercus cerris*, var. *Lucombeana* (= *Q. cerris* × *Q. ruber*). Miss Ormerod also recorded the occurrence of the galls of *Andricus circulans* and *Dryophanta Taschenbergi* on this Oak. She observed the last named also on typical *Q. cerris*. Trail and Rolfe noted the galls of *Neuroterus baccarum* on *Quercus dentata*. Rolfe makes the highly interesting observation that he "never found a gall of the Common Oak on either an American species or on the European *Q. cerris*, the 'mossy cupped' oak, even when the branches interlaced, which shows the existence of some barrier to their dispersal."

I find, however, in Houard's "Zoocécidies des Plantes d'Europe," the galls of *Biorrhiza pallida*, *Dryophanta Taschenbergi*, *Andricus trilineatus*, *A. testaceipes*, *A. ostreus*, *Neuroterus albipes*, *N. lenticularis*, and *N. baccarum*, mentioned under *Quercus cerris*.

Economic Notes

There are not many troublesome pests amongst the gall-causing Hymenoptera; the attacks of the great majority are confined to uncultivated plants. Some representatives which are not gall-causers often cause damage in other ways; we may mention *Nematus ribesii* Curtis, which defoliates gooseberry and currant bushes; *Lophyrus pini* Curtis, which eats the leaves of the Scotch Pine; *Athalia spinarum* Fabr., which occasionally plays havoc in turnip fields; and *Cephus pygmaeus* Linn., which attacks the stems of various cereals and grasses.

Two gall-causing **Cynipidae** are alluded to in Miss Ormerod's Manual—viz., *Cynips Kollari* and *Neuroterus lenticularis.* "With the exception of the marble gall and the common spangle galls, which sometimes so completely load the back of the leaves as to cause premature withering, it does not appear that any kinds are often materially hurtful." We have had abundant evidence, though, during the past summer (1911), of the destructive influences of the so-called "oyster" gall, caused by the presence of the larvae of *Andricus ostreus.* Quite early in the summer the leaves of *Quercus pedunculata* in many districts showed marked peripheral browning. The conditions they presented are well shown in Plate I., Figs. 1 and 2, which show respectively the upper and lower surface of a leaf gathered on August 23, when many of its galls had fallen away. In the Haslemere district the majority of the trees shed their leaves prematurely, and it cannot be doubted that their growth was seriously checked. Cameron remarks* concerning *Cynips Kollari:* "Various attempts have been made to utilize these galls for ink-making purposes, but without any practical result, owing to the paucity of tannic acid they contain as opposed to the Aleppo and other galls—only some 17 as against over 50 per cent. The only use made of them is for ornamenting fancy baskets, fern-

* "British Phytophagous Hymenoptera," iv., p. 113.

cases, etc. That the species is injurious in many instances there can be no doubt. It only frequents stub or young oaks, not over 3 or 4 feet high. These, when they appear in numbers in nurseries, they frightfully distort, and not infrequently render saleless."

The leaf-rolling saw-fly (*Blennocampa pusilla*) has of late years attacked cultivated Roses in various parts of England, in some cases to such an extent that no blossoms were produced.

Cultivated Orchids are sometimes attacked by *Isosoma orchidearum* (see J. O. Westwood's paper in the "Gardener's Chronicle," 1885, vol. xxiv., p. 84, on "Galls on the Roots of Orchids"). The surface of the stem is covered with distinct swellings, and exhibits necrosis in irregular patches. There are circular or oval holes leading into cavities of irregular form. The base of the leaf, and often the floral sheath, is thickened and swollen; other parts bear isolated rounded swellings. Attacked buds are swollen, globular, and thickened. Westwood observed these galls on a species of *Dendrobium*, and Fitch found them on *Cattelya Triansei.*

CHAPTER III

GALLS CAUSED BY BEETLES (COLEOPTERA)

IT is estimated there are about 150,000 species of beetles; of these, about 3,300 have been found in Britain. Very few are gall-causers. Mosley's catalogue gives only eight, Connold, in 1909, observed that the number of gall-producing British beetles is less than twenty. As a matter of fact, there are more than forty, but the galls caused by the majority are very obscure. Houard enumerates about 110 Continental forms.

Beetles have four wings; the posterior membranous pair are entirely concealed, when at rest, beneath the hard anterior pair (elytra), which cover the back as a protective shield. The larva is a maggot-like creature with a head, three thoracic segments, and eight to ten abdominal segments. Three pairs of small thoracic legs are sometimes present, but are often wanting; in some species they are present in the early larval stage, but not in the later.

The larval condition is occasionally very prolonged. In the *Cerambycidae* (Longicorns) the development of the larva frequently extends over a year, but when living under disadvantageous conditions—for instance, in dry wood containing little or no nutriment—the larval state may be prolonged to an almost incredible length of time. Imagines have emerged from a table twenty to twenty-eight years after the felling of the tree from which it was made. Sereno Watson relates a case of a certain Longicorn in which it seems probable that the life-cycle extended over a period of no less than forty-five years.

The duration of the pupal state is short, usually varying from one to three weeks. Beetles chiefly pupate in the earth or near the feeding-place; many species make a cocoon of bits of earth or wood. The pupa is usually soft. The imago is soft and almost colourless upon emergence, and sometimes takes several days to attain normal coloration and hardness. The use of the beautiful sculpturing so frequently seen on the elytra is quite unknown. Beetles are difficult to rear, and, considered collectively, very little is known about their life-histories. Dr. Sharp observes that "they exhibit, however, extreme diversity correlative with the great specialization of so many beetles to particular kinds of life. Most beetles must have exactly the right conditions to live in." Thus, many families of plants are free from coleopterous parasites, whilst others are infested with many, and the gall-causers in a particular family are generally members of a single genus.

Amongst the Leguminosae we find numerous galls caused by species of the genus *Apion*. As a rule the flowers and stems are attacked. The beetles of this genus are popularly known as "pear-shaped weevils," the long and arched proboscis and globose body causing a resemblance to a long-stalked pear.

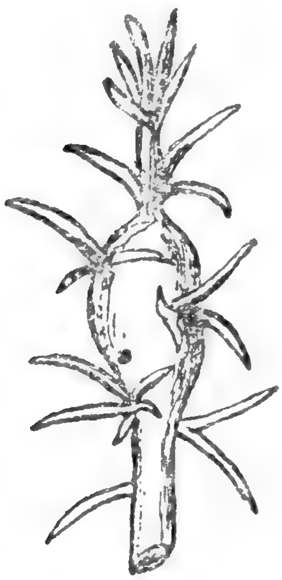
The larvae of *Apion scutellare* cause ovoid or rounded swellings about the size of a large pea on young stems of the Common and Lesser Gorse, and those of *A. immune* give rise to similar deformities on the Broom. Clovers frequently suffer from the attacks of various species—*e.g.*, the Purple Clover is infested by *A. assimile*, *A. varipes*, and *A. apricans*. *A. varipes* causes excrescences to arise on the roots; the others attack the flowers, and the floral axis becomes hypertrophied.

Apion Gyllenhali attacks the stems and petioles of Vetches. Amongst the Labiatae we also find *Apion vicinium* infesting the Catmint and other species, the larvae living in a multilocular swelling on the stem.

In the Compositae *Apion sorbi* attacks Chamomiles (*An-*

themis cotula and *A. arvensis*), causing elongation of the receptacle, with an ovoid cavity within. *Apion laevigatum* also causes a similar gall on the latter.

Amongst the Polygonaceae various Docks are frequently attacked by members of the genus *Apion*. Four species attack the Sorrel Dock (*R. Acetosa*)—namely, *A. affine*, *violaceum*, *frumentarium*, and *humile*, causing pronounced fusiform swellings on the stems and petioles.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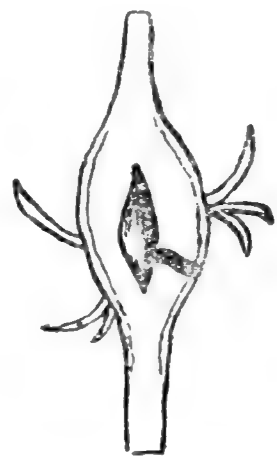
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FIG. 6—SHOOT OF *Ulex europaeus* WITH OVOID GALL OF *Apion scutellare*. (1/1.)

FIG. 7—SECTION OF SAME, SHOWING THE CENTRAL CAVITY AND THE EXIT BURROW. (1/1.)

Two or three species of *Anthonomus* attack the flower buds in Pyrus, otherwise the order Rosaceae is remarkably free from attacks of gall-causing beetles.

Miarus campanulae attacks various species of Campanula; the larvae infest the seed capsules, and cause great hypertrophy.

Many representatives of the Scrophulariaceae are attacked by beetles belonging to the genus *Mecinus*. The root and base of stem of the Common Toadflax produce yellowish fleshy galls of the shape and size of a pea, containing the larvae of *M. collinus*, a rare insect, occurring only in the

south of England. Similar galls are caused on this plant by *M. linariae*.

The swollen ovaries of the Figwort, Marsh Speedwell, and Brooklime, result from the presence of the larvae of *M. beccabungae*. Members of the allied family, Plantaginaceae, are also attacked by species of *Mecinus*. The larva of *M. collaris* causes an elongated swelling on the floral axis of the Seaside Plantain. The flower head of the Hoary Plantain is sometimes galled by *Mecinus pyraster* (see Plate VI., where Fig. 1 shows a normal flower spike contrasted with an afflicted one, Fig. 2, containing the larva). The beetle (magnified; it is only 4 mm. long) is shown in Fig. 3. It is widely distributed. It also galls the floral axis of the Ribwort Plantain.

Many cruciferous plants are attacked by beetles of the genus *Ceuthorrhynchus*. The galls, for the most part, are rounded or fusiform swellings at the base of the stem and on the roots. The most familiar of all coleopterous galls are those caused by the presence of the larvae of *Ceuthorrhynchus sulcicollis* Gyllenhal (*pleurostigma* Marsh) on the roots of Turnips, Swedes, and various kinds of Cabbage. They are often coalescent; a single gall is a smooth rounded protuberance, usually about the size of a large pea, situated on the upper part of the root, just below the surface of the ground. The beetle is minute, about 3 mm. long. The elbowed antennae are situated on the long, stout proboscis, a characteristic of the weevil family (*Curculionidae*) to which these beetles belong. The eggs are generally deposited in holes made by the proboscis, usually one in each hole. The larvae are yellowish-white, thick, legless, and armed with dark brown jaws. They are at first difficult to observe within the gall, but later they hollow out its centre and are easily found. When full fed, the larva leaves the gall, and makes a hard case of earth, etc., in which it pupates. The imago emerges about six weeks or two months later. This gall may be found throughout the year, sometimes with living tenants even in severe weather.

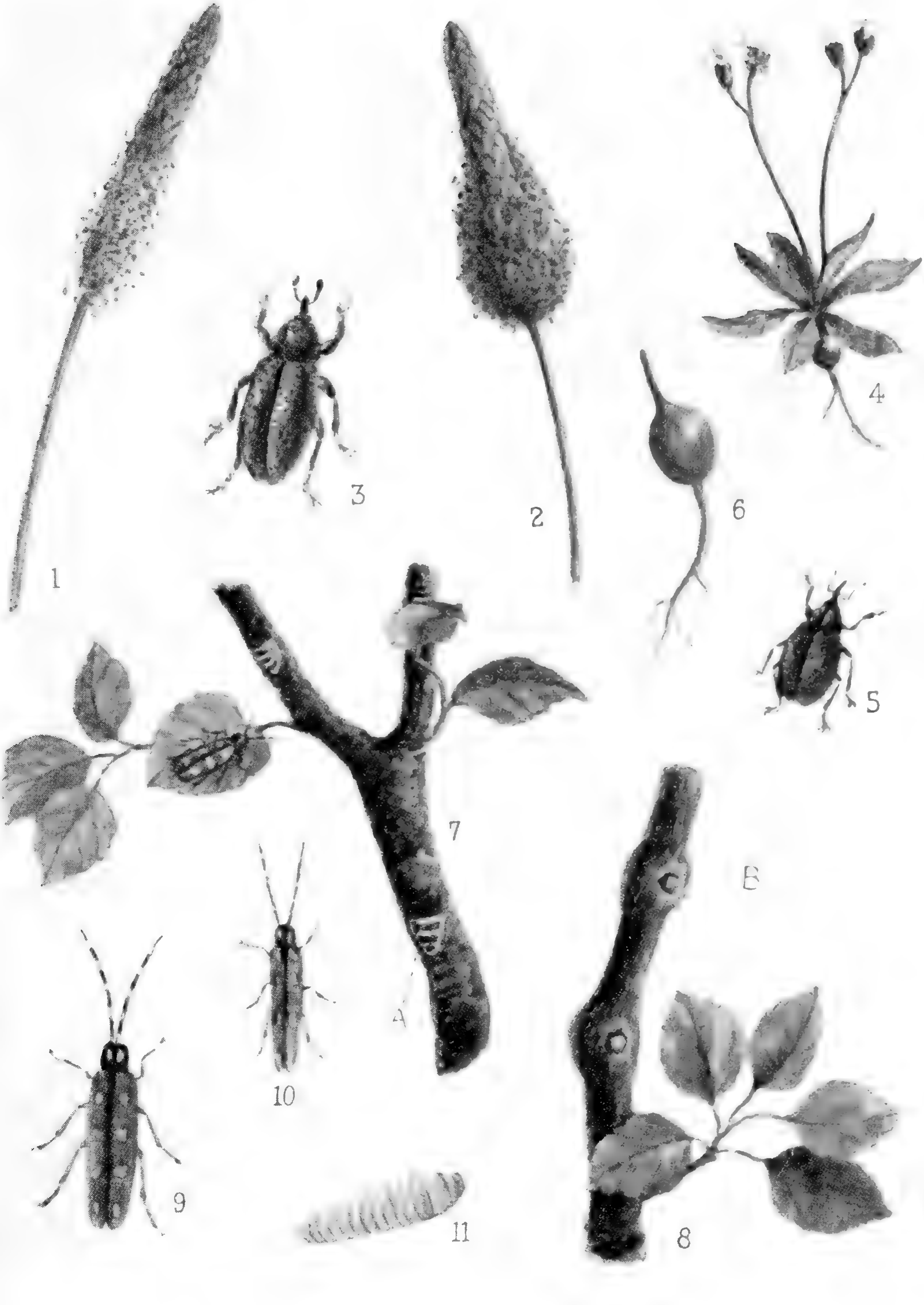
Miss Ormerod observes that "the maggots bear being frozen hard without the slightest apparent injury, for on being thawed they will at once go down into soft earth and begin to build up their earth-cases."

C. sulcicollis Gyll. must be carefully distinguished from *C. sulcicollis* Paykull. The latter is not a British insect; there are Italian records of its larvae causing large fusiform swellings on stems of *Dentaria pinnata* Linn.

Plate VI., Fig. 4, shows the Common Whitlow Grass with a spherical gall on the upper part of its root, caused by the presence of the larva of *Ceuthorrhynchus hirtulus*. Fig. 5 gives a magnified view of the insect, and Fig. 6 the gall twice actual size. This beetle is not common. The gall sometimes occurs at the base of the stem, amongst the rosette of leaves.

Three species of *Ceuthorrhynchus* cause galls on the Hedge Mustard. The catalogue should be consulted for particulars of these and many others.

Large galls are sometimes caused by the larvae of *Saperda populnea* in Poplar and Willow stems in the southern counties. This beetle belongs to the Longicorn family (*Cerambycidae*), which comprises insects of oblong shape, with long antennae, and elytra often dull from the presence of minute hairs, which are frequently arranged in patterns. Its life-history is briefly as follows: In June, or early in July, the female, upon finding a suitable young branch, cuts a shield-like mark in the bark, and deposits a single egg at the base of the shield (Plate VI., Fig. 7, *a*). This operation is repeated three or four times along the same branch at intervals of about 30 mm. It is said that the presence of the egg starts the hypertrophy, but it is more probable that no swelling begins to take place until the larva (Fig. 11) is hatched. The larva eats its way into the pith, making galleries above and below the entrance-hole, and remains in the larval state until the second autumn, when it pupates in the branch. In the following June or July the imago emerges from a hole in the swelling, which is usually on



GALLS CAUSED BY BEETLES ON ASPEN STEMS, ROOT OF WHITLOW GRASS AND FLOWERHEAD OF THE HOARY PLANTAIN

the side opposite to that on which the egg was placed. The pronounced rounded or fusiform swellings and the poor development of leaves cause affected shoots to be seen easily in the second year of the attack (Fig. 8, *b*). As usual amongst the Coleoptera, the female (Fig. 9) is the larger. It is about 17 mm. long, and more definitely marked than the male (Fig. 10), which averages about 13 mm. in length. *Saperda populnea* is the sole British coleopterous gall-causer on the Willows, and *Brachonyx pineti* on the Conifers. The presence of the larvae of the latter on the Scotch Pine causes the needles to be stunted and thickened in the middle, the edges meeting to form a cigar-shaped gall.

Smicronyx jungermanniae Reich causes, on the Continent, pea-like or fusiform galls, one or two celled, in the stems of the Great Dodder (*Cusuta Europoea* Linn.); and *S. caecus* Reich gives rise to similar galls on the Lesser Dodder (*Cuscuta epithymum* Murr.). These insects are recorded in the lists of British Coleoptera, but I have no records of their causing galls on the Dodder in this country.

Economic Notes

Many beetles are well-known pests of garden, farm, and forest, though comparatively few are gall-causers. The galls caused by *Ceuthorrhynchus sulcicollis*, the Cabbage and Turnip weevil, have been described above. Miss Ormerod observes that "these galls do little harm in themselves, so far as Turnips are concerned—that is, unless they are very numerous, or cause decay by wet lodging in the hollows in the galls from which the maggots have escaped. But with the Cabbage it is different. Here the gall growths on the old stocks are not available for food, as they are with Turnips; they carry off the sap in the wrong direction, besides inducing decay."*

Hylurgus piniperda bores into young shoots of the Scotch Pine; the mouth of the burrow is surrounded by a white

* "Manual of Injurious Insects," second edition, p. 35.

lump of resinous matter. Similar exudation occurs at the aperture of burrows in this tree made by certain lepidopterous larvae that are usually classed as gall-causers; but the absence of hypertrophy of the branch around the burrow and of excrement within, serve at once to distinguish the burrow of *H. piniperda* from that of a caterpillar.

Pseudo-Galls

A few beetles roll up parts of living leaves into marvellous little pouches or rolls for the reception of their eggs. It is possible that such productions may be mistaken by some observers for true galls, but they are outside the domain of the cecidologist. One of the most remarkable of these pseudo-galls is that made by *Attelabus curculionoides* from the apical half of the Sweet Chestnut leaf. It is a minute cylinder, about 8 by 4 mm.; it hangs from the other half of the leaf, supported by the midrib only. Each cylinder contains a golden egg.

CHAPTER IV

MOTH GALLS

GALLS caused by the presence of the larvae of lepidopterous insects are not common. The order Lepidoptera contains two sections—the *Rhopalocera*, or Butterflies (antennae clubbed, hind-wings without a frenulum), and the *Heterocera*, or Moths (antennae variously shaped; rarely clubbed, but when they are, the frenulum is present).

No butterflies give rise to galls, and but few moths cause what may be considered true galls. The life-cycle consists of four stages—egg, larva, pupa, and imago. The eggs are laid on the plants on which the larvae feed. The larvae—usually spoken of as caterpillars—are worm-like creatures with a head and thirteen segments. The first three segments are thoracic, and each carries a pair of short limbs. Two, three, or more of the abdominal segments adjacent to the thoracic are legless, but some of the posterior ones have abdominal feet. The termination of the body carries a pair of thick legs, of somewhat different shape to the abdominal feet, known as "claspers." The larvae are mostly vegetable feeders, deriving nourishment from the fluid part of the plant, the solid part passing from the alimentary canal in dry (usually) pellets, called "frass." Prolonged larval state, so frequently seen in the Coleoptera, is rare amongst the Lepidoptera, but the pupal state frequently lasts nine months. The pupa or chrysalis is remarkable in its outer skin forming a hard chitinous shell.

The following list of British lepidopterous gall-causers is arranged according to the food-plants of the larvae:

Agrimony, Hemp (*Eupatorium cannabinum* Linn.).

Pterophorus microdactylus Hübner: Swelling in the stem.

Alder (*Alnus rotundifolia* Mill.).

Argyresthia Goedartella Linn.: Staminate catkins swollen and deformed.

Epiblema tetraquetrana Haw.: Twig swollen at base of a petiole.

Aspen (*Populus tremula* Linn.).

Nepticula argyropeza Zell.: Petiole swollen close to the leaf.

Laspeyresia corollana Hb.: Shoot swollen.

Honeysuckle (*Lonicera Caprifolium* Linn., *L. Periclymenum* Linn., and *L. Xylosteum* Linn.).

Orneodes hexadactyla Linn.: Flowers swollen, not opening.

Juniper (*Juniperus communis* Linn.).

Lobesia permixtana Hüb.: Knotty swelling on the stem.

Knotgrass (*Polygonum aviculare* Linn.).

Augasma aeratella Zell.: Bud greatly hypertrophied.

Pine, Scotch (*Pinus sylvestris* Linn.).

Laspeyresia cosmophorana Tr.: Resinous swelling in the bark of a branch.

Dioryctria splendidella H. S.: Lumps of resinous exudation in a branch.

Rhyacionia resinella Linn.: Globular mass of resinous exudation at the apex of a twig.

Plantain, Ribwort (*Plantago lanceolata* Linn.).

Tortrix paleana Herb.: Flower spike swollen and deformed.

Oak (*Quercus robur* Linn.).

Pammene splendidulana Guénée: Young branches swollen.

Stenolechia gemmella Linn.: Extremity of a branch incurved and swollen.

Heliozela stanneella Fisch. V. R.: Midrib and petiole swollen.

Poplar, Black (*Populus nigra* Linn.).

Gypsonoma aceriana Dup.: Young branches swollen.
Sciapteron tabaniforme Rött.: Knotty swellings on the shoots.

Poplar, Grey (*Populus canescens*, Sm.).
Gypsonoma aceriana Dup.: Young branches swollen.

Poplar, White (*Populus alba* Linn.).
Gypsonoma aceriana Dup.: Young branches swollen.
Sciapteron tabaniforme Rött., var. *rhingiaeforme* Hüb.: Branch swollen.

Ragwort, Common (*Senecio Jacobaea* Linn.).
Phalonia atricapitana Ste.: Stem swollen.

Ragwort, Marsh (*Senecio aquaticus* Hill.).
Platyptilia isodactyla Zell.: Stem swollen.

Willows (*Salix*, various species, see catalogue).
Grapholitha Servilleana Dup.: Fusiform swellings on the older branches.

Willow Herb (*Epilobium*, several species, see catalogue).
Mompha decorella Steph.: Swelling in the stem.

The resin gall moth (*Rhyacionia** *resinella* = *Retinia resinella*) occurs chiefly in the northern part of England and in Scotland. It is common in parts of Perthshire and Inverness. Mr. Adkin gives the life-history as follows: "The egg is deposited on the twigs of the Fir, and, upon hatching, the young larva eats through the bark, forms the narrow gallery, and feeds upon the soft wood of the tender shoot then growing, this operation probably occupying its first summer. It now taps the bark on the opposite side to that by which it entered, and causes the sap to flow, which by its own weight spreads along the twig in the direction of the stem, congeals, and forms a resinous lump, the inside of which the larva gnaws away, at the same time devouring the bark and a portion of the wood next to it, as it becomes

* The genus *Retinia*, though a well-established one, was displaced by *Evetria*. The latter has been recently replaced by *Rhyacionia*—a typical instance of the senseless and irritating changes in nomenclature which are constantly being made in all departments of zoology and botany.

covered, until it has obtained a sufficient size, and thus makes a habitation in which to pass its first winter. With the approach of spring the sap begins to flow again, and this probably supplies the larva with nourishment; it attains its most rapid growth at the time when the flush is greatest. It remains as a full-fed larva through its second autumn and winter, pupates in April, and the moth emerges at the end of May or early in June, thus occupying a period of two years in completing its metamorphosis." In weakly trees the shoot above the resinous nest dies, and numerous lateral shoots appear just below it. Plate VII., Fig. 8, presents a reduced view of a gall; Fig. 9 is the moth, which is slightly less than 1 inch in wing expanse; Fig. 10 a longitudinal section of a gall, showing the larval cavity, half the actual size.

Mompha decorella (Plate VII., Fig. 7) is widely distributed in England, and is frequent in some districts in the southern counties. Its principal food-plant is the Broad-leaved Willow Herb (*Epilobium montanum*). Barrett observed it in the Haslemere district in 1865, and published notes on the galls in the first volume of the *Entomologist's Magazine*. Fig. 6 shows a gall, half natural size, on the stem of *Epilobium parviflorum*. It is fusiform, and about 20 mm. long.

Augasma aeratella is confined to the south-east corner of England, and is rarely found in abundance. Shoreham is a well-known station for it. Messrs. Eustace Bankes and B. A. Bower have kindly sent me galls from that locality. Plate VII., Fig. 1, shows Knotgrass bearing the terminal pouch-like galls, natural size; Fig. 2, the insect slightly enlarged; Fig. 3, longitudinal section of a gall, twice natural size.

Nepticula argyropeza is widely distributed in England. It is a minute insect, only 6 mm. in wing expanse. Plate VII., Fig. 5, gives an enlarged view of it; Fig. 4 shows its gall, a somewhat spherical swelling on the upper part of the petiole of an Aspen leaf, one-half actual size.

SOME GALL CAUSING MOTHS WITH THEIR GALLS

Grapholitha Servilleana attacks various species of Willow. The larvae burrow into the older branches, avoiding the one-year shoots. Fusiform swellings from 10 to 20 mm. long, and from 5 to 8 mm. broad arise. The exit is situated in the lower part of the elongated central cavity.

The following records of lepidopterous gall-causers are taken from Houard's "Zoocécidies":

Epiblema luctuosana Dup.: Causes swollen nodes, each 10 by 4 mm. in *Centaurea nemoralis* Jordan. British?

Galechia mulinella Zell.: Causes woody swellings, 20 by 15 mm. in the roots of *Bartsia aspera* Lange. British?

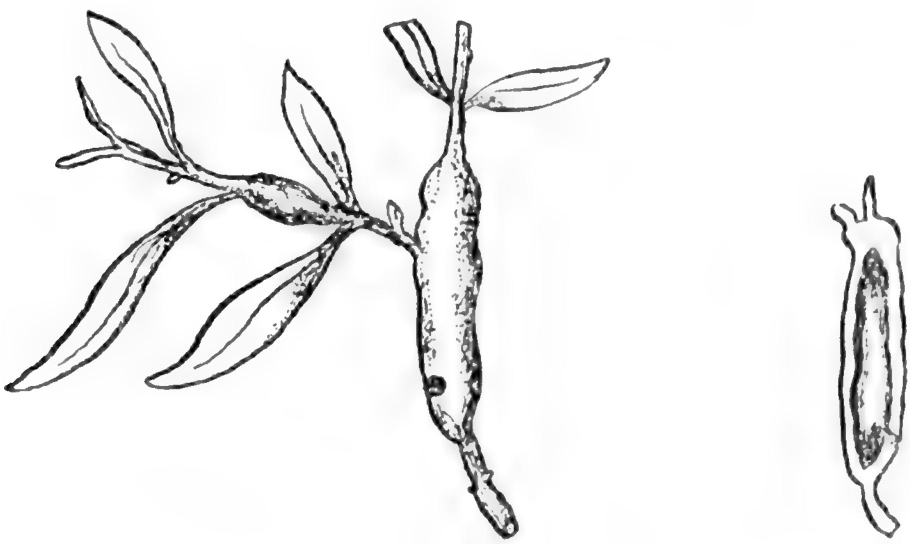


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FIG. 8—WILLOW STEMS GALLED BY LARVAE OF *Grapholitha Servilleana*. (1/1.)
FIG. 9—SECTION SHOWING THE LARVAL CAVITY. (1/1.)

Cynaeda dentalis Schiff.: Causes swellings with nodular surface on the midrib of the radical leaves of an Alkanet (*Anchusa*, sp.). British?

Houard also alludes to a gall caused by *Sesia formicaeformis* Esper on the Common Osier (*Salix viminalis*). It consists of a more or less rounded and woody excrescence involving the entire circumference of a branch, and containing a large central cavity. It is given as a very doubtful record. I am not aware of any records of galls in British Willows

resulting from the presence of the larvae of this well-known insect.

In all the galls so far alluded to in this chapter the burrow remains open, and provides an easy exit for the imago; such is the rule with lepidopterous galls. There is an exception to the rule which I may be pardoned for alluding to, though it concerns an African moth, because of its interest. *Oecocecis guyonella* (Tineidae) deposits its eggs in *Limoniastrum guyonianum*, a plant that is the favourite food of camels on the deserts to the south of Algeria. This plant is frequently covered with sand. The gall completely encapsules the larva, a feature usually seen in dipterous galls. I am not aware of a similar record. This observation was recorded by Guénée many years ago.* The advantage of the sealed cavity is obvious.

Economic Notes

There are no very troublesome pests amongst lepidopterous gall-causers. *Rhyacionia resinella* is the chief British example. By destroying the terminal bud of young Scotch Pines it retards the growth of the tree, and where it occurs in abundance, as it does in a few localities in Scotland, it is becoming a serious pest. The only way to keep it in check is to cut off and burn the galls during the second year.

The larvae of *Dioryctia splendidella* and *Laspyresia cosmophorana* may affect seriously the Scotch Pine when present in numbers. In these, as in the case of *R. resinella*, the mouth of the burrow is marked by a lump of resinous exudation. In all there is usually slight hypertrophy of the twig at the attacked part, which feature only, justifies their inclusion in this chapter.

* *Ann. Soc. Ent. France* (4), x., 1870.

CHAPTER V

GALLS CAUSED BY FLIES (DIPTERA)

THE majority of flies are two-winged; a few aberrant forms, such as fleas and certain ticks, are wingless. The wings are comparatively small; behind them are a pair of little erect bodies, the halteres or poisers. The maggots or larvae are usually footless, with a small and indistinct head. The pupa may be either exposed and hard, or soft and enclosed in a capsular seed-like body.

Dr. Sharp* observes: "About 40,000 species of Diptera have been discovered, but these are only a tithe of what are still unknown to science. The order is not a favourite one with entomologists, and by the rest of the world it may be said to be detested. . . . Nevertheless, Diptera have considerable claims to be classed as actually the highest of insects physiologically, for it is certainly in them that the processes of complete life-history are carried on with the greatest rapidity, and that the phenomena of metamorphosis have been most perfected. A maggot, hatching from an egg, is able to grow with such rapidity that the work of its life in this respect is completed in a few days; then, forming an impenetrable skin, it dissolves itself almost completely; solidifying subsequently to a sort of jelly, it, in a few days, reconstructs itself as a being of totally different appearance and habits, in all its structures so profoundly changed from what it was that the resources of science are

* "Insects," part ii., vol. vi., pp. 438, 439; "Cambridge Natural History," vol. vi.

severely taxed to demonstrate any identity of the organs of the two instars."

The antennae are of great importance in the classification of Diptera. The majority of dipterous galls are caused by the **Cecidomyidae** or gall-midges, an extensive family of minute flies, remarkable in the rather long antennae, furnished with whorls of hairs; many writers have commented upon the beauty of these insects, and of the antennae of the males in particular. The larvae of all Cecids are not parasites on plants; some feed on dead animal matter, others prey upon Aphides and Mites, and some are cannibals.

The peculiar spatula or anchor process which projects from the prothoracic segment in some species is probably used either for body movement, for perforating, or, in species provided also with horny papillae at the terminal segment, for causing the remarkable leaps executed by the larvae.

The gall-midges are difficult to preserve, being so small and fragile; in spite of this they have received much attention, and about a thousand species have been described and named from various parts of the world. The original genus, *Cecidomyia*, has undergone much revision of late years, and has been split up into many genera, the chief being *Asphondylia*, *Contarinia*, *Hormomyia*, *Oligotrophus*, *Perrisia* (including many species at one time placed in the genus *Dasyneura*), *Rhabdophaga*, and *Rhopalomyia*.

Before proceeding to describe some familiar dipterous galls, attention may be directed to certain curious productions which have been recorded as occuring on fungi on the Continent and in America. It seems desirable to bring them to the notice of British cecidologists, as but little is known respecting them at present. The first observation was published by Professor Boudier* in 1893, in a paper "Sur les Causes de Production des Tubercles Pileux des Lames de Certains Agarics," in which he records his discovery of minute oblong or rounded tubercles, about

* See *Rev. Gén. Bot.* (Paris), vol. v., pp. 29-35.

1 mm. in diameter, on the gills of *Pleurotus ostreatus*, *Tricholoma personatum*, *T. sordidum*, *T. nudum*, and *Clitocybe* sp. Each tubercle consisted of a fine whitish pubescence, and contained either the egg of a fly, a fragment of earth, or grain of sand, or, very frequently, excreta of a larva. Excepting, perhaps, those arising from the presence of an egg, these productions cannot be looked upon as true galls.

In 1899 Vogler alluded to little isolated or gregarious bodies, 10 to 15 mm. high, of variable shape, on the surface of a mushroom. The extremity of each was rounded, provided with a mouth less than 2 mm. in diameter, and contained a cavity 7 to 8 mm. long. The following year Riedel discovered that these tubercles were caused by a Dipteron belonging to the genus *Ditomyia*, many members of which pass the larval state in woody fungi.

In 1899 and 1900 Rübsaamen published an illustrated note on similar tubercles found on the pileus of a *Polyporus*. Each tubercle was subcylindrical, 5 to 8 mm. high, provided at its apex with a large crateriform opening margined by a deep black zone. The internal cavity was a tube 7 to 10 mm. long, with walls of a firmer consistency than the tissue of the normal fungus. His figure depicts these galls grouped together on the margin of the fungus adjacent to the hymenial surface.

In 1903 Thom recorded in the *Botanical Gazette*, Chicago, that *Omphalia campanella* Batsch is sometimes deformed by the larva of a fly. Dr. Ross* has recently figured the hymenial surface of *Fomes applanatus*, bearing cylindrical tubercles 8 by 4 mm.

Mr. C. G. Lloyd, the well-known American mycologist, published in his *Mycological Notes*, April, 1911, the following note: "While collecting at Albany I noted a Myxomycete with curious chimney-like tubes, that on examination proved to be the home of some insect—some sort of 'fly,' I judge. The Myxomycete is *Enteridium*

* "Die Pflanzengallen (Cecidien) Mittel und Nordeuropas," 1911, Taf. iv., Fig. 75.

rozeanum (of Lister), or *Enteridium splendens* (of MacBride), but what the 'fly' is I do not know. The ways of Nature are most curious. Here we have a fly that probably lays its eggs only on this particular species of Myxomycetes, and it is a plant that I have noted very rarely in the woods. The common *Lycogala epidendrum*, which is a very similar plant, was developed in abundance by the side of this *Enteridium*, and not a specimen was affected. A mycologist might confuse these two plants, but the fly knew them apart. While it may be a well-known phenomenon to the entomologists who study such things, these 'fly' cases in Myxomycetes seemed very strange to me."

Lloyd's note is of special interest to me, because some two or three years ago I found near Haslemere a Myxomycete with similar tubes projecting from its surface. From a cursory inspection of the specimen in the field I thought it was a *Lycogala*. I noted that the tubes, which I judged to be the cocoons of some dipterous insects, were all empty; each had a small circular hole at the apex. Unfortunately, my specimen was lost before its specific identity was ascertained. It is highly probable that it was an *Enteridium* and not a *Lycogala*, and that *Enteridium* is everywhere infested by a Dipteron which is at present unknown.

The necessity for careful investigation of the contents of galls is emphasized by another note in the same number of Lloyd's *Mycological Notes*. He points out that a fleshy growth on branches of the Southern Cypress (*Taxodium distichum*) has been described by mycologists as *Merulius cupressi*, *Cyphella cupressi*, and *Cantharellus cupressi*. Though Berkeley long ago said it was an insect production, Saccardo placed it amongst the fungi. Lloyd received living specimens from North Carolina, and remarks: "It did not take me long to decide that Berkeley was right, and that it is an insect gall, for the cellular structure is quite different from that we find in fungi, and in addition I found on the inside of each specimen a little orange grub. I sent specimens to Mr.

Mel. T. Cooke, who makes a special study of the galls, and he advises me as follows: 'There is but one species of gall reported on *Taxodium distichum*, and I have specimens of that species. It is entirely different from the one you send me. The gall which you send is of insect origin without doubt, and apparently belongs to the genus Cecidomyia.'"

One of the commonest of British galls is caused by the presence of the larvae of *Perrisia ulmariae* on the leaves of the Meadow Sweet. Wherever this plant occurs—it ranges throughout the British Isles and Europe—the observer will find the galls in abundance during the summer. The fly attacks the leaf in late spring, and the galls appear soon after as small, glabrous, light green, umbonate pustules on the upper surface, with whitish projections on the lower one. They are usually situated on the midrib or the larger lateral veins, and are often densely gregarious, causing the leaf to pucker, but not otherwise producing very marked distortion. Over 200 galls have been counted on one leaf. Later, the gall assumes a reddish-brown or pinkish tint on the upper surface, the lower remaining greenish-white. The umbo vanishes from the upper part, and the lower assumes the form of an elongated cone covered with a felt of whitish hairs. The cavity is somewhat triangular. The larva is yellowish-orange. It pupates in the point of the cone. A circular separating line is formed in the tissue, to enable the cap to come away easily when the fly emerges. This is easily demonstrated; by seizing the point of the cone with forceps it comes away quickly, and always in exactly the same way. The larva frequently bears an external parasite, a minute, active, hyaline, worm-like creature.

Perrisia ulmariae also attacks *Spiraea filipendula.* It is noteworthy that the galls on this plant differ very markedly from those on *S. ulmariae;* the truncated cone opens on to the upper surface of the leaf, the pustule being on the inferior one. As a rule the galls caused by any species of insect on closely allied plants present very slight differences

in shape and position; we may recall the bean-shaped galls caused by the hymenopteron *Pontania pedunculi* on *Salix capraea* and *S. cinerea.* It is possible that *Perrisia ulmariae* attacks the Dropwort, piercing the upper surface of the leaf, and that another species, indistinguishable to all appearances from it, attacks the Meadow Sweet, each insect keeping to its particular plant. Allusion has already been made to the highly interesting fact that ten species of gall-gnats which attack *Salix humilis* in America are practically indistinguishable the one from the other, though each causes a distinctive gall. It may be suggested, there-

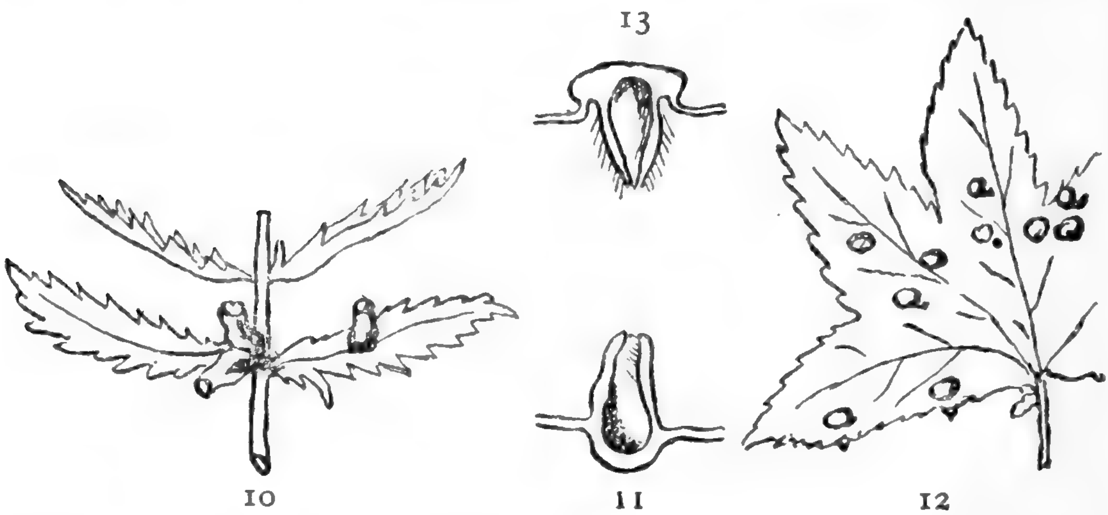

FIG. 10—*Spiraea Filipendula* GALLED BY *Perrisia ulmariae.* (1/1.)
FIG. 11—SECTION OF A GALL, SHOWING APERTURE ON UPPER SURFACE OF THE LEAF. (2/1.)
FIG. 12—*Spiraea ulmaria* GALLED BY *Perrisia ulmariae.* (1/1.)
FIG. 13—SECTION OF A GALL, SHOWING APERTURE ON THE LOWER SURFACE OF THE LEAF. (2/1.)

fore, that *Perrisia ulmariae* of the Dropwort deserves specific rank under the name of *Perrisia filipendulae*.

The Germander Speedwell has a hairy stem, and the under surface of the leaves is covered with short white hairs. The terminal leaves of this very familiar plant are commonly attacked by *Perrisia veronicae* (Plate VIII., Fig. 2, magnified). The leaves become folded upwards and the hairs are abnormally developed, forming a gall which looks very like a bunch of white hairs (Plate VIII., Fig. 1). It

is one of the few felt-like galls caused by the presence of dipterous larvae; the majority arise from the attacks of mites, and the felt often appears on the surface of a leaf which is normally quite smooth.

The galls of *Perrisia veronicae* occur throughout the summer and autumn. The pouch in large specimens may be ½ inch in diameter; the larvae are gregarious, usually seven or eight together in a gall. They are of a gorgeous orange hue, which deepens as they approach maturity. The pupae may be found in August, but larvae are present in some galls as late as the end of September. The gall laid open is a most attractive object to view with a binocular microscope, using a 2-inch objective and transmitted light. The lower margins of the two leaves forming the pouch are joined together; the upper are closely adpressed only. Sometimes the felting extends to the base and petiole of the second pair of leaves. The apex of all attacked leaves remains normal. A similar gall occurs on the Ground Ivy, caused by *Perrisia glechomae*. *Perrisia veronicae* occurs throughout Europe and the British Isles. On the Continent it attacks *Veronica officinalis* and *V. montana*, causing similar galls, but I am not aware that they have been observed on these plants in Britain.

The greenish gall induced by *Perrisia urticae* on the Common Nettle affords another instance of hypertrophy of hairs on the galled parts of a plant. Its European range equals that of the preceding. It is unilocular, containing but a single cavity, and multilarval, the cavity containing two or more larvae. Seldom solitary, these galls usually occur on the lower part of the leaf, with an elongated opening on the upper surface; but they appear occasionally on the stem and flower stalks, and are often tinted violet. The white larvae leave the gall in autumn, and pupate in the earth.

The margins of the pinnules of the Common Bracken are often rolled inwards and greatly hypertrophied (Plate XVIII.) consequent upon the attack of *Perrisia*

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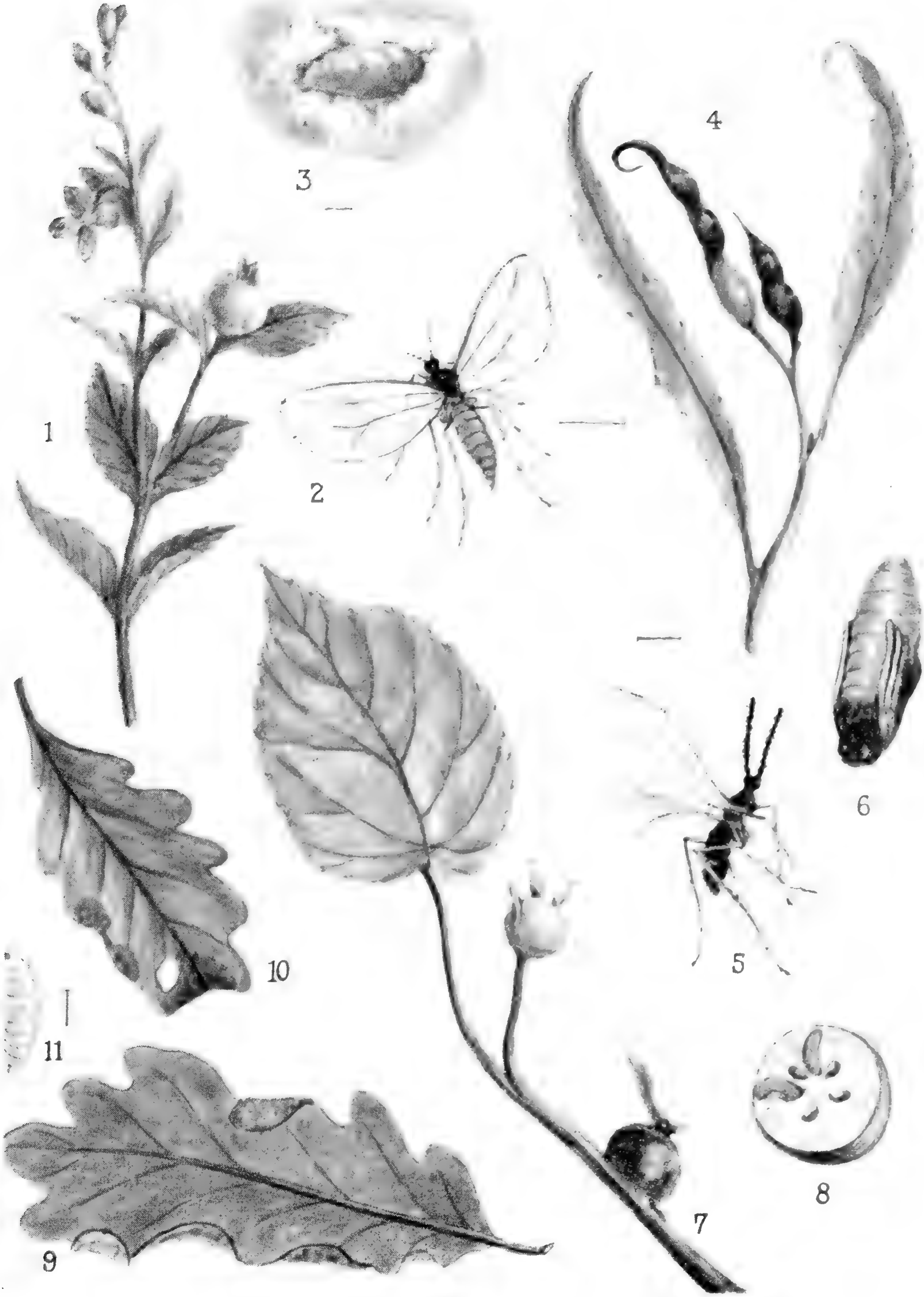
filicina. The roll is cigar-shaped and shining black at maturity; it contains a single pale orange-yellow larva, which pupates in the earth. This gall has a wide range in Europe and the British Isles. An allied species, *Perrisia pteridicola* Kieffer, causes a similar gall on Bracken in Germany and Central Europe, but has not as yet been observed in this country. The hypertrophy is feebler; the larvae are gregarious and colourless.

The larvae of *Perrisia terminalis*, perhaps better known to English dipterists under the name of *Dasyneura terminalis*, cause swollen brown galls in the apices of the shoots of the White Willow and the Crack Willow (Plate VIII., Fig. 4). As many as thirty of the reddish larvae may be found in a single gall, which is formed by the rolling together of the terminal leaves, which also become thickened and brown. The larvae pupate either in the gall or in the earth. Fig. 6 gives a magnified view of a pupa from the gall shown above it, and Fig. 5 the elegant little fly, highly magnified, the expanded wings of the insect measuring only $\frac{3}{10}$ inch from tip to tip. This gall is frequent wherever *Salix fragilis* occurs. The illustrations are from specimens I gathered in a garden in Gower Street, London, in July, 1910.

Perrisia marginem-torquens causes the margins of the leaves of the Osier and other Willows to become more or less tightly rolled inwards. The roll often extends the entire length of the leaf, and consists of an aggregation of little yellow or reddish pockets, each about 3 mm. long, and each containing a single larva. The gall of *P. Inchbaldiana* is similar, but is bent like a bow and smaller at each end. Though usually gregarious, these galls are rarely coalescent, and the margin is never continuously rolled.

Other well-known galls on Willows are caused by gall-gnats of the genus *Rhabdophaga*. *R. saliciperda* causes hypertrophy of woody tissue on branches up to 4 inches in diameter. When numerous, as they often are, these galls collectively form an elongated spindle-shaped (fusiform)



GALLS CAUSED BY THE LARVÆ OF FLIES ON GERMANDER SPEEDWELL, WILLOW, LIME AND OAK

swelling. The bark ultimately falls away, exposing the little holes which had been occupied by the larvae. They must not be confused with the galls caused by *R. salicis*, which are pronounced fusiform or rounded swellings, usually on one-year twigs (Plate IX., Fig. 10) of various Willows; the larvae bore into the pith (Fig. 11). There are excellent illustrations of them in Connold's "Vegetable Galls," Plates XXVI., XXVII., XXVIII.; unfortunately, XXVI. and XXVII. are erroneously attributed to *R. saliciperda.*

The familiar rosette galls, consisting of bunches of leaves at the apex of shoots of many Willows, are caused by *Rhabdophaga rosaria.* Another rosette gall of Willows is caused by *R. heterobia;* it may be known from the preceding

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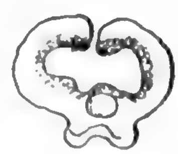

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FIG. 14—STEM OF YELLOW BEDSTRAW WITH GALLS CAUSED BY THE PRESENCE OF THE LARVAE OF *Perrisia galii.* (1/2.)
FIG. 15—SECTION OF A GALL. (1/1.)

by the white pubescence on the leaves. This gnat also attacks the male catkins of *S. triandra*, causing the filaments of the stamens and the scales to become thickened and covered with a white woolly pilosity. Theobald observes that the Willow flies live only twenty-four hours, and are attacked by several parasites.

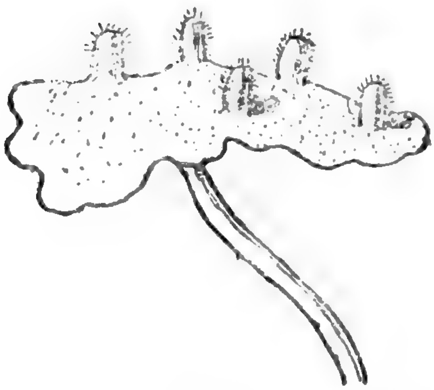
The attacks of *Perrisia galii* cause large hypertrophies on the flower stalks and terminal part of the stem of the Yellow or Ladies Bedstraw. Sometimes the diameter of a gall is ten or twelve times that of the stem on which it is produced. Each gall may contain but a single cell; usually three or four are present. The larvae are orange-yellow,

and pupate in the earth. The Yellow Bedstraw occurs throughout Britain, but *Perrisia galii* is by no means widely distributed, apparently occurring chiefly in the south and east. It attacks various species of Bedstraw on the Continent, but I am not acquainted with British records.

The inflorescence and the young shoots of the Common Lime are frequently attacked by *Contarinia tiliarum*. The gall takes the form of an elongated or rounded tumour, sometimes 10 mm. in diameter, green at first, becoming reddish (Plate VIII., Fig. 7). It contains numerous larvae of a sulphur-yellow hue (see magnified section, Fig. 8). Other members of the genus attack various plants. There are fifteen recorded British species of gall-causing *Contarinia*, exactly one-quarter of the number known in Europe.

A much higher percentage of the members of the genus *Oligotrophus* are gall-causers in this country. Houard records nineteen Continental species. Eleven occur in Britain, causing galls of very attractive appearance and of great interest. Perhaps the commonest of all is the hypertrophied bud of the Yew, resulting from the presence of the orange-coloured larvae of *Oligotrophus taxi*. The gall consists of a mass of adpressed leaves surrounding a whitish, fleshy central part. It is usually terminal. Late in May many of the galls contain pupae; these are orange-coloured at first, but gradually become darker. The leaves are then erect and nearly straight. Early in June the fly emerges. (It is an orange-coloured creature, 5 mm. long, and not more than 9 mm. in expanse of wing.) The apical leaves then curve and twist, so perceptibly altering the appearance of the gall that it is then quite easy to distinguish those containing pupae from the empty ones. It is doubtful if this change is always delayed until the fly has emerged, for I have found flies crushed between the leaves at the mouth of the gall. They are so minute and delicate that it is not to be marvelled at that many meet an untimely death in their compulsory journey to the outer world through this dangerous channel of moving leaves.

The cylindrical hairy outgrowths so frequently seen, in shady situations, on the upper surface of leaves of the Ground Ivy arise from the presence of the larvae of *Oligotrophus bursarius.* The eggs are deposited in spring. The gall is green at first, becoming reddish or purple at maturity. It is about 4 mm. high, and contains a single larva. The interior is smooth, but the aperture is surrounded with hairs. These galls are usually gregarious, falling away after the larvae have left them to pupate in the earth, and leaving circular holes in the leaf. The gall is sparsely covered with hairs.



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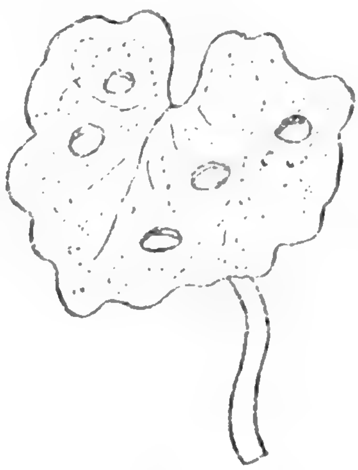

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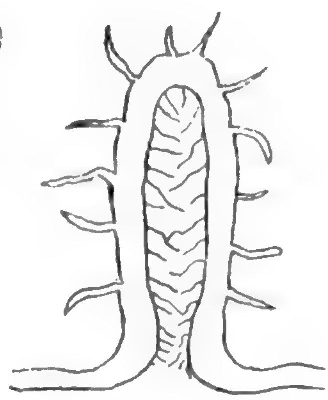

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Fig. 16—Ground-Ivy Leaf with Galls caused by the Presence of the Larvae of *Oligotrophus bursarius.* (1/1.)
Fig. 17—Ground-Ivy Leaf after the Galls have fallen away. (1/1.)
Fig. 18—Section of a Gall. (5/1.)

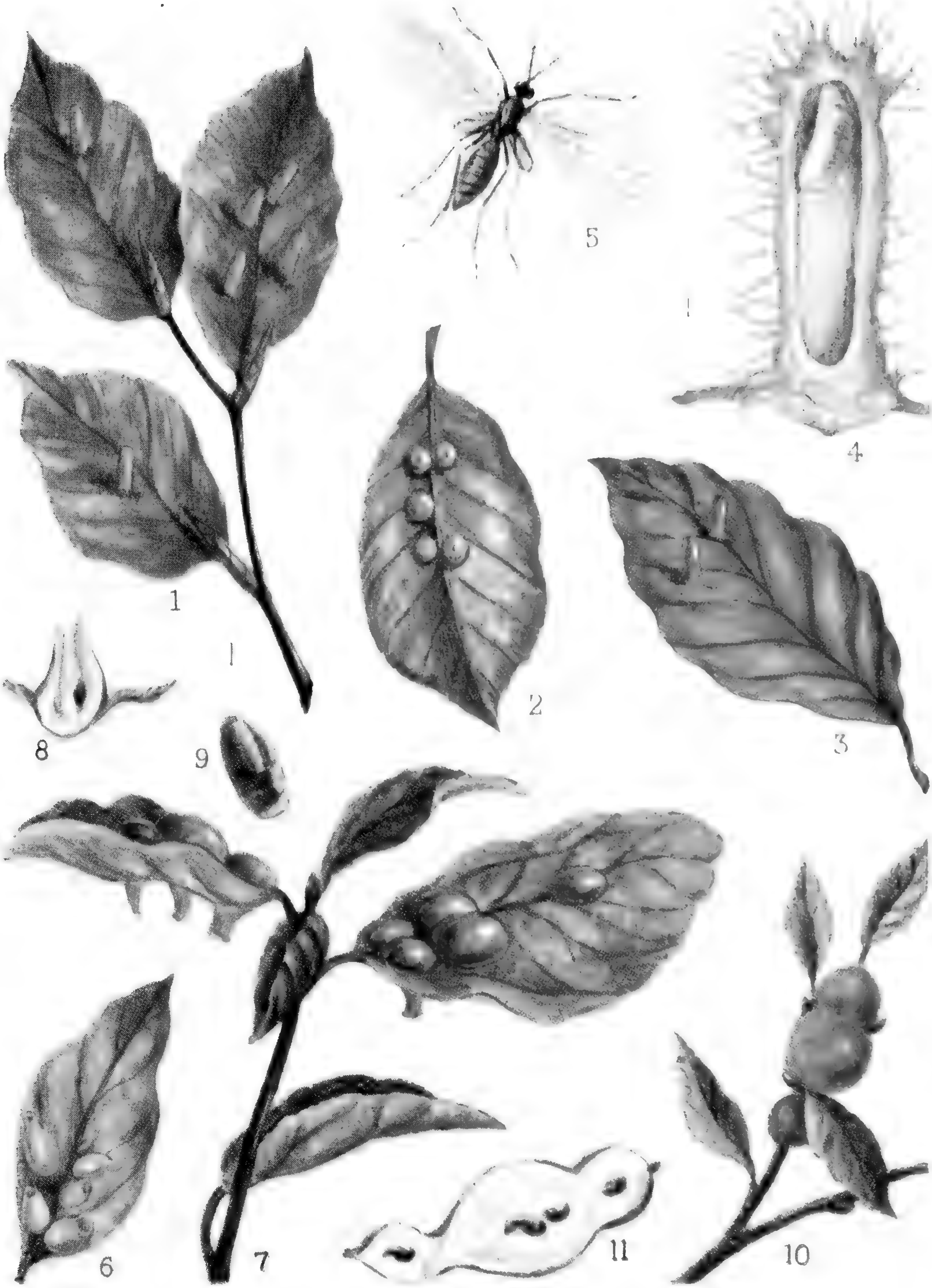
The Dogwood is not attacked by many gall-causing parasites. On the Continent, an Aphis, three mites, and the dipteron *Oligotrophus corni* attack the leaves, and the Neuropteron *Lestes viridis* Van der Lind causes little swellings on the stem. The galls caused by these parasites are obscure and of local distribution, excepting that of *Oligotrophus corni*, which occurs throughout Europe, and is the only insect which causes galls on the Dogwood in this country. Its galls are large and very distinctive (Plate IX., Fig. 7). They take the form of a truncated cone, divided into two or three lobes at the apex, which is

on the inferior side of the leaf. They are pale green at first (Fig. 6), becoming reddish-brown or purple at maturity. Each gall contains an orange-coloured larva, which pupates in it (Fig. 8, section; Fig. 9, pupa) or in the earth. It is sometimes plurilocular, containing numerous cells. It is not common in Britain, but has been recorded from several counties.

The little hairy tubular galls on the upper surface of Beech leaves are caused by *Oligotrophus annulipes* (Plate IX., Fig. 5, magnified). Like numerous other galls, those of *O. annulipes* are extraordinarily abundant in certain years, and uncommon or rare in others. In the autumn of 1906 they were very numerous in the Haslemere district, also in the Beech woods adjoining Heyshott Down, and elsewhere on the South Downs.

In 1910 they were so scarce that we experienced some difficulty in finding any for exhibition at the Haslemere Museum, and they were almost equally scarce in 1911. This gall stands up on the leaf like a little tube, about 5 mm. high and 2 mm. in diameter (Plate IX., Fig. 1), usually on or close to the midrib. It is yellowish-green, with irregularly tuberculated surface at the apex, and is covered with greenish or purplish-brown hairs. Its position is indicated on the lower surface of the leaf by a slight circular elevation (Fig. 2) with a reddish or purplish tint in the centre. A magnified section is shown in Fig. 4. The interior is rough and fibrous, and contains a white larva. The gall falls away at maturity, leaving a circular scar on the leaf. The larva pupates in the earth. The best time to find these galls is in October, when the leaves are falling. Leaves bearing them will be quickly recognized by the conspicuous patch of green surrounding the galls when the remainder of the leaf is brown (Fig. 3). The oasis is usually margined with yellow.

The galls caused by *Mikiola fagi* occupy a somewhat similar position on Beech leaves, but are easily known by their more ovoid form, larger dimensions—8 to 10 mm. high,



DIPTEROUS GALLS ON BEECH, WILLOW AND DOGWOOD

5 mm. in diameter—absence of hairs, and the thick and very hard walls. They are of rare occurrence in Britain. On the inferior surface of the leaf there is a circular pustule surrounded with a fringe of hairs. These galls have been detected on fossil leaves of *Fagus pliocenica* Saporta.

Plate XXX. depicts galls on leaves of the Mealy Guelder Rose, caused by the presence of the larvae of *Oligotrophus Solmsii*. The pustules are lenticular, more or less thickly scattered over the leaf (never truly coalescent), and are about 5 mm. in diameter. Green at first, they soon become red, and are dark purple at maturity. The gall shows on the lower surface of the leaf as a thin circular whitish disc covered with minute hairs (see the lowest leaves in the illustration). Each gall contains a yellowish larva, which pupates in the earth. It is rare in Britain; its first record dates from June 12, 1904, when I found it on the Downs near Maidstone. Miss Spittal informs me that it was very plentiful about Winchester in the summer of 1911.

An equally rare gall is caused by *Oligotrophus Leemei* on leaves of the Wych Elm (Plate XXIII.). It occurred in great abundance in the large wood above Weston-super-Mare in June, 1910. Usually the midrib and the larger lateral veins bear the galls, but the petiole is occasionally involved, becoming greatly hypertrophied. Not infrequently the leaf is pressed backwards against the twig from which it grows. Much distortion results when young and unfolding leaves are attacked (Plate XXIII,. *c*). On the lateral veins the gall usually consists of a rounded yellowish swelling below, with the aperture above (at *b* is shown the upper surface of a leaf studded with little pin-like holes, which are the orifices from which the larvae have emerged). When the midrib is attacked, the openings are for the most part on the under surface of the leaf, and are lateral (*c*). The gall is very hard. The larval chambers may be easily made out with a pocket-lens; each contains an active yellowish larva. On June 26 I noticed that many larvae had left to pupate, and that the empty galls could be easily recog-

nized by the brown tint around the orifice. The change of colour is perceptible within a few hours of the departure of the larva. Connold received these galls from Worksop in 1909, the first British record; his photograph is here reproduced.

The galls caused by *Rhopalomyia millefolii* on the Common Milfoil are probably not so uncommon as was at one time supposed. They are usually situated at the top of the root on a level with the earth, a position which makes them very inconspicuous (Plate XXXI.); sometimes the leaves are attacked, and even the flowers. They are usually coalescent when growing at the base of the stem. This gall is an elegant structure about the size and shape of a hemp-seed, green at first, becoming reddish-purple, and finally black. The opening is stellate, with four or five lobes; the interior contains a single yellow larva. To breed the flies, old galls should be obtained in May, and kept in test-tubes or glass-topped boxes.

Galls caused by *Cystiphora sonchi* on the radical leaves of the Common Sow Thistle are shown in Plate XXXII. *Sonchus arvensis* is of wide distribution in Britain, but its gall is rare, being recorded only from the south of England. The pustules are evident on both surfaces of the leaf, but less so on the lower one. They are purple above, greenish below, and average about 4 mm. in diameter. Usually each gall contains a white larva, but Connold describes it as containing two. The right-hand figure in the plate is the lower surface of a leaf with numerous galls; some of them show plainly the orifice from which the insect has emerged.

Two species of *Macrodiplosis* attack Oak leaves, causing localized folding of the margin. The galls are very different, though not infrequently confused. They appear in June. Those depicted on Plate VIII., Figs. 9 and 10, are caused by *M. dryobia*. Some of the lobes are folded downwards until they touch the inferior surface; between the folds one to six whitish larvae may be found. The surface above the fold is tinted red; thus, the gall is easily recognizable (Fig. 10).

The outer surface of the folded lobe is spotted with white and red.

The gall caused by *Macrodiplosis volvens* consists of the folding upwards of that part of the margin which lies between two adjacent segments. The fold is never so broad as that of *M. dryobia*, and there is no marked discoloration. There are one to four pale orange larvae under each fold. The photographs in Connold's "Oak Galls," Plate LXIII., and "Plant Galls," Fig. 200, depict the galls of *M. volvens*, not *M. dryobia*, as therein stated.

The galls so far alluded to in this chapter are caused by flies belonging to the family *Cecidomyidae*. The other family of British Diptera which contains gall-causers is the **Muscidae**, to which allusion must now be made. These flies have the bristles of the antennae feathered. The species are generally large and robust (house-flies and blow-flies are typical examples), and gall-causers are comparatively few. In the *Cecidomyidae* we have twenty-seven genera of gall causers, in the *Muscidae* only thirteen.

The majority of Muscid gall-causers infest plants belonging to the family *Compositae*. The genus *Tephritis* is perhaps the most extensive. Various species attack the flower head (capitulum), causing it to swell and remain unopened—*e.g.*, *T. conura* attacks the inflorescence of the Melancholy Thistle, and *T. eluta* causes the capitulum of the Black Knapweed to become hardened. For other species reference should be made to the catalogue.

Urophora is another well-known genus. The larvae of *U. cardui* cause a very pronounced rounded or fusiform swelling on the stem (usually near the apex) of the Creeping Thistle. It is hard, glossy, green or brownish, often attaining the size of a walnut. The larval cells are numerous, each containing a single occupant. If these galls are gathered in autumn and kept till the following June, there will be no difficulty in breeding the pretty little flies.

Trypeta bardanae attacks the Common Burdock, causing the seed-capsules to become swollen and deformed. *Chlorops*

taeniopus and *Oscinis frit* are very destructive to cereals. *Myopites inulae* and *M. Frauenfeldi* cause the receptacle of the Fleabane and the Golden Samphire to become swollen and almost woody. As the galls are identical, and Mr. Collin says the flies have never been well differentiated, they are possibly forms of the same species.

Economic Notes

There are many destructive pests amongst the gall-causing Diptera. One of the worst offenders is the Hessian Fly, *Mayetiola destructor* Say, which causes swelling of the base of the haulm and sharp bending of the stem (just above the part containing the larva) of wheat, barley, and rye. It was first noted as a British insect by Miss Ormerod. A long account of it is given in her "Manual of Injurious Insects," and it also forms the subject of leaflet No. 125 issued by the Board of Agriculture. It was prevalent in this country in 1886 and 1887, but, though still occasionally met with, it has not caused any serious damage since. It is said to infest Timothy Grass and Couch Grass in Russia.

The larvae of *Asphondylia pimpinellae* F. Löw cause the flower stalks and the seeds of the Common Parsnip to become swollen.

A. Müller, in 1870, recorded in the seventh volume of the *Entomologist's Monthly Magazine* the occurrence of galls caused by *Asphondylia dorycni* F. Löw on *Dorycnium suffruticosum* Vill. (*pentaphyllum* Scop.). They were about 6 mm. long and 3 mm. in diameter, were situated at the junction of the lateral branches, and were covered with long white unicellular hairs. The larvae pupated in the galls.

Westwood recorded, in 1885, the presence of galls on the roots of orchids (*Dendrobium* sp.). They were situated on the radicle, and attained the size of a wheat grain, which they also resembled in shape. The ovoid cavity contained an orange-yellow larva. This Cecid was not determined. On the Continent *Cecidomyia cattleyae* Moll. causes galls of

pea-like form on the aerial roots of various species of *Cattleya*, doing much damage; and *Cecidomyia rhododendri* causes bud-like growths on the twigs of various species of Rhododendron.

The Cabbage-root fly, *Phorbia brassicae*, is not only a Cabbage pest, but often does considerable mischief in turnip plots, causing swellings which resemble somewhat those of the Turnip gall weevil. Full particulars concerning its life-history, etc., are given in Theobald's second report, "Economic Zoology," p. 68. It also attacks the Shepherd's Purse, Charlock, Jack-by-the-Hedge, Wall Mustard, and the Stock, but I am not aware that it causes galls to arise on these plants.

Certain members of the genus *Diplosis* are well-known pests. *D. flava* and *D. tritici* attack wheat; the larvae of the former give rise to rosettes of leaves on the haulm; those of the latter induce swelling of the glumes and flowers. *Diplosis pyrivora*, the Pear Midge, not infrequently causes serious losses in Pear orchards. It attacks the blossoms, and deposits its eggs with the long egg-laying tube. The eggs hatch in from four to six days. About a fortnight later the fruit begins to swell abnormally, and is gradually hollowed out by the larvae, which, in common with other members of the genus, have the power of leaping. (See Board of Agriculture leaflet, No. 53.)

The "Ribbon-footed corn-fly," *Chlorops taeniopus* Miegen, causes the malformation known as "gout" in the haulm of Wheat, Rye, and Barley, most frequently on Barley. "The attack takes its common name of 'gout' from the swollen state of the heads when the ear is unable to burst the sheaths. Whilst the plant is still young, and the forming ear is wrapped in the sheathing leaves, the fly places her eggs either within these leaves or so that the maggot can make its way through them to the ear; there it usually eats away some parts of the lower portion of the ear, and then gnaws, or rather tears, a channel down one side of the stem to the uppermost knot, and beneath the leaves the

maggot changes to a reddish chrysalis, from which the gout-fly appears about harvest-time."*

The frit-fly, *Oscinis frit* Linn. (*vastator* Curtis), does much mischief to cereals and pasture grasses in Europe and America. The larva eats into the heart of young plants; the new shoots become swollen and distorted, the malformations resembling those induced by eelworms. The gall-gnats of Willows and Osiers above alluded to not infrequently occur to an injurious extent. The Board of Agriculture has issued a leaflet (No. 165) concerning them.

Though Loudon, Selby, and others, held the opinion that the Yew seldom suffers from the attacks of insects, there are numerous recorded instances of damage resulting from the attacks of *Oligotrophus taxi*,—*e.g.*, Dr. Lowe observed trees at Dinder, near Wells, that were much infested "on their upper branches, which were stunted and unhealthy-looking, while the lower branches, which were almost free from galls, were well grown and vigorous." These galls are more abundant in the southern counties than in the northern, and are said to be unknown in Scotland.

* Eleanor Ormerod, "Manual of Injurious Insects" (second edition), p. 76.

CHAPTER VI

GALLS INDUCED BY PLANT-LICE (HOMOPTERA)

THE order Hemiptera comprises insects provided with a mouth specially adapted for piercing the tissues and sucking the sap from the plants on which they feed. It contains two suborders, Heteroptera and Homoptera. In the insects classed under the former the anterior wings are of unequal consistency, and the front of the head does not touch the coxae; in those of the latter the anterior wings are homogeneous, and the front of the head and the coxae are in contact. With the Heteroptera we are not concerned; two representatives of the family *Tingidae*—viz., *Copium clavicorne* Linn. and *C. teucrii* Host.—deform the flowers of *Teucrium chamaedrys* and *T. montanum* on the Continent, but I am not aware of their occurrence in Britain. Three families of the Homoptera contain gall-causing insects—the *Aphidae*, or "green-fly"; the *Psyllidae* (springing plant-lice or leaf-fleas); and the *Coccidae* (scale insects and mealy-bugs).

The majority of homopterous gall-causers are **Aphidae**. Most people are acquainted with them under the names of "blight" and "green-fly." These insects are remarkable for the enormous production of young by parthenogenetic females, and the rapidity with which the young themselves attain the same function; within a summer the progeny of a single individual is almost innumerable. Huxley calculated that the produce of a single Aphis would, if all the individuals survived, in the course of only ten generations "contain more ponderable substance than five hundred

millions of stout men—that is, more than the whole population of China." It is generally held that Huxley's estimate was below the mark! Luckily, they have numerous enemies which keep them well in check, but many species are often serious pests in gardens. The generation with which gardeners are mostly familiar is the parthenogenetic young produced by wingless females hatched from eggs laid in the previous autumn. The production of living young by females without male intervention may go on for several generations. Later in the year, coincident with decreased food-supply and lowering of the temperature, sexual insects are produced, and the females deposit fertilized eggs, which yield wingless females in spring. These apterous viviparous females are often termed "mother queens"; they are also spoken of as "fundatrices." In the classified catalogue of galls at the end of this book the expression "Aphis" refers to the apterous viviparous female. Metamorphosis often takes place amongst the parthenogenetic generations, and the habits are very varied. It is the rule, however, that winged forms appear when food is scarce, and wingless females are usually the sexually perfect ones. Many Aphides produce enormous quantities of a sweet sticky substance known as "honey-dew," which is emitted through two tubes or "cornicles" situated on the back. Kirby and Spence remarked: "You have doubtless observed what is called the honey-dew upon the Maple and other trees, concerning which the learned Roman naturalist Pliny gravely hesitates whether he shall call it the sweat of the heavens, the saliva of the stars, or a liquid produced by the purgation of the air. Perhaps you may be aware that it is a secretion of Aphides, whose excrement has the privilege of emulating sugar and honey in sweetness and purity. . . . It issues in liquid drops from the abdomen of these insects, not only by the ordinary passage, but also by two setiform tubes placed one on each side just above it."

Probably the best-known of all aphid galls are those caused by species of *Chermes* on the Common Spruce Fir.

They resemble immature cones in size and shape, and are often alluded to as "Pineapple" galls. It has been discovered within recent years that several insects were at one time comprised under the name of *Chermes abietis*, and even now there is much that is obscure concerning their life-history.

In the true *Chermes abietis* the life-cycle is confined to the alternation of two parthenogenetic generations on the Spruce. The larva hatched from an egg in autumn pierces a bud or its vicinity with its long proboscis, and thus firmly anchors itself for the long winter sleep. These larvae, or *fundatrices*, as they are often termed, may be easily found in winter by carefully examining the base of the shoots with a good pocket-lens. They are a dirty-yellow colour. In spring, about April—but the time depends upon meteorological conditions—without moving its position, the *Fundatrix* begins to suck, and attains maturity in about a month. It undergoes three moults, one every ten days or thereabouts. As soon as it begins to suck, and not before, precocious growth arises in the cells in the neighbourhood of the cambium, at the point where the apex of the deeply buried proboscis lies, and spreads rapidly outwards. In the early stage there is little or no external evidence of altered growth, but a section cut through the bud will at once reveal it: the affected part looks bleached. Later the needles become swollen at the base. Being closely crowded they quickly begin to press upon one another, and four grooves result at the base of each needle. As elongation proceeds, the needles separate slightly, leaving a space above each. These spaces are afterwards occupied by the larvae. At this stage the gall is easily seen with unaided vision. In the meantime the Aphis has been steadily sucking and waxing fat, at the same time secreting much white, waxy, wool-like matter which covers her up, yet makes her presence more apparent. She has undergone her three moults (ecdyses) and arrived at maturity. It is now about the second week in May, and she commences to lay her eggs, continuing to do so through-

out the month, and perhaps well on into June. A mass of at least 100 light yellow eggs may be found beside her, each firmly fastened to the twig by a hair-like stem. Having fulfilled her destiny, the *Fundatrix* dies. The eggs hatch at the time when the spaces are formed—a perfection of adjustment which excites our deepest admiration—the larvae immediately crawl up into them, and begin to suck.

The edges of the cavities are often ornamented with purple or reddish hairs. They continue to swell until the

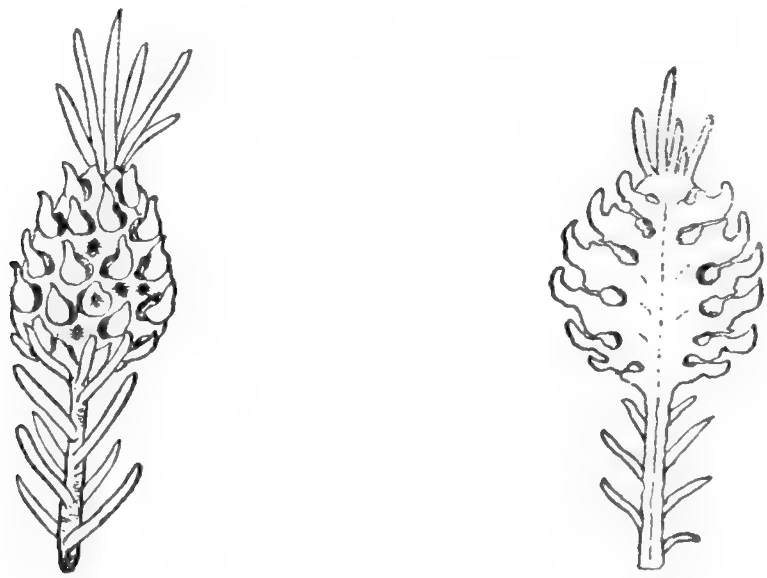


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Fig. 19—Pseudo-Cone on Shoot of Common Spruce caused by the presence of *Chermes abietis*, showing Larvae upon the Cone. (1/2.)

Fig. 20—Section of a Gall, showing the Numerous Larval Cavities. (1/2.)

margins meet and the larvae are completely enclosed within. Each cavity contains many larvae—fifty or more. Buckton remarked that even at a moderate computation a single gall may contain 2,000 inhabitants. Within these vegetable palaces the larvae undergo several moults and pupate. At the end of July or early in August gall growth ceases, and shrinkage of the margins of the cavities immediately follows, leaving slits through which the pupae escape. They crawl out upon the gall and the surrounding

needles, and here undergo the fourth and last moult, casting off the pupal skin, which is left attached to the needles. The winged insects, or **Alatae**, are all non-migratory females They are yellow, with black head and upper thorax, and always have the third joint of the antennae distinctly shorter than the fourth, an important point in diagnosis. These winged females lay their eggs at the base of the buds, and die. From these eggs arise the **Fundatrices**, and the life-history as above set forth begins anew. Particulars as regards the length of time the production of unisexual generations may continue are wanting; there is evidence, however, that it may extend over four years. At one time it was thought there was no male, but Blochmann and others have shown that this idea was erroneous.

More than twenty years have elapsed since Blochmann announced the existence of a sexual generation in *Chermes*. Subsequently, Blochmann, Dreyfus, and Cholodkovsky, discovered, independently, the periodic migration of one generation from the Spruce to the Larch, and the return of a later generation the following year to the Spruce. Later, Cholodkovsky discovered the phenomenon known as "parallel series" in connexion with the generation on the larch. It has been investigated chiefly in this country by Burdon. His valuable paper,* entitled "Some Critical Observations on the European Species of the Genus Chermes," is indispensable to all workers in this difficult genus, as it contains tables of the results of Cholodkovsky's investigations.

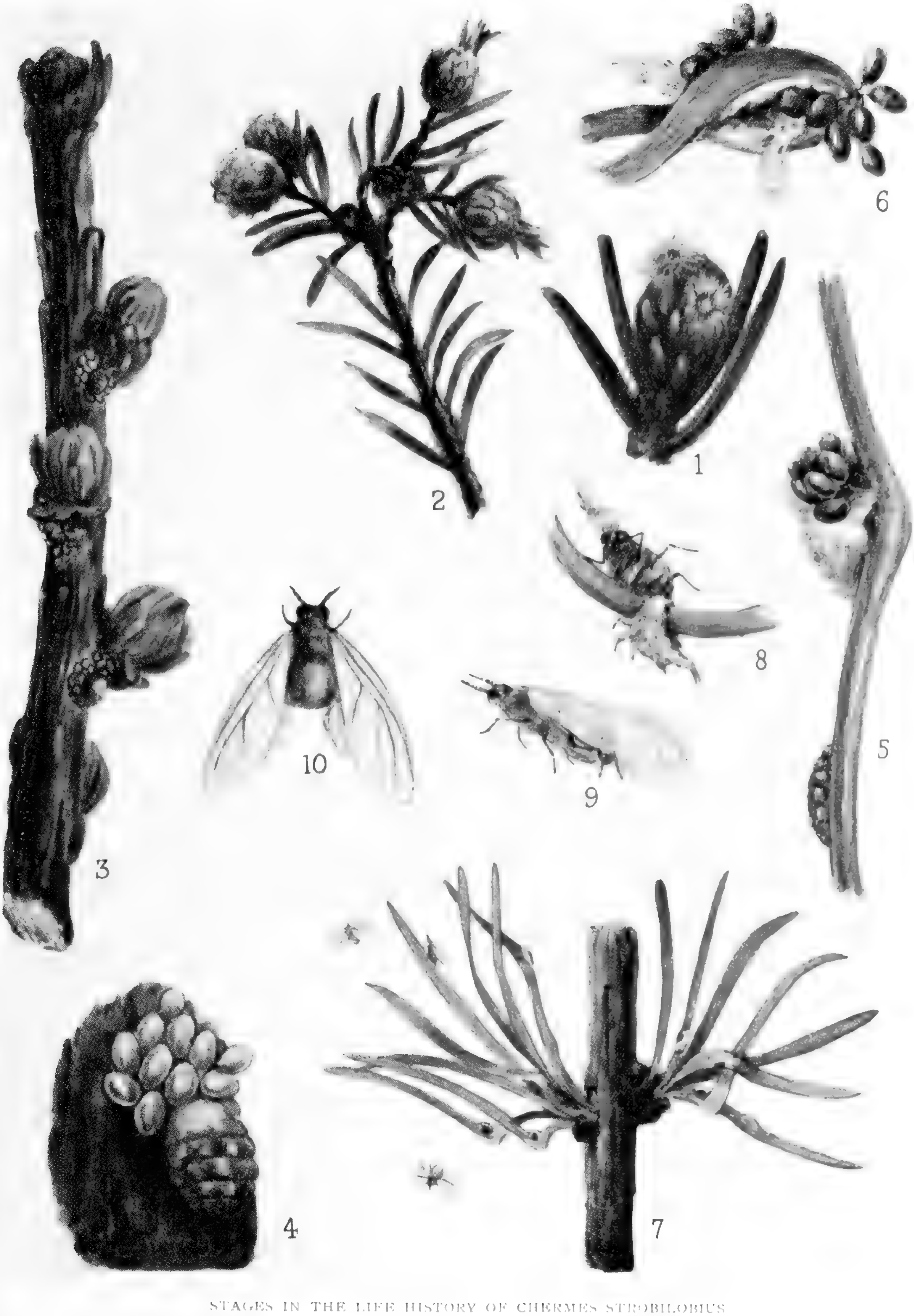
Even the casual observer of the "Pineapple" galls on the Spruce cannot fail to note that they present marked differences in size and colour, and that some open much earlier than others. The largest of these galls is attributed to *Ch. viridis*, a species which is the "double" of *Ch. abietis*; it was formerly regarded as a variety of it. The Fundatrices and the Alatae differ from those of *Ch. abietis* in the darker colour (some shade of green) and the green eggs. The

* *Journ. Econ. Biol.*, 1908, vol. ii., No. 4.

Alatae migrate to the Larch in August, where they deposit numerous dark green eggs; the larvae from these are known as **Colonici**. They are almost identical with the Fundatrices, but are perhaps a little smaller and not so woolly. They hibernate on the Larch stems, but cause no gall growth. Their eggs are deposited in spring, and produce winged insects styled **Sexuparae**. These are yellowish-green in all stages of growth, and the adults are almost identical with the Alatae, though much smaller (1 to 5·5 mm. long), and have very little wool. The Sexuparae fly back to the Spruce, and lay about ten greenish-yellow eggs on the needles. The yellowish, rather active larvae which hatch from these eggs feed on the needles near to the dead body of the parent, and may be found from May to August. The adults, termed **Sexuales**, are of both sexes, and appear in August; the males are greenish-yellow, the females sulphur-yellow. Each female deposits a single yellow egg at the base of a shoot. From these eggs larval **Fundatrices** are hatched, and the life-cycle of five generations—Fundatrix, Alatae, Colonici, Sexuparae, and Sexuales—is again repeated.

Burdon failed to find sufficient difference in colour to distinguish easily the green and yellow broods. I have experienced the same difficulty in this. In the Alatae the fourth joint of the antenna may be a little longer or even shorter than the third, but they are, as a rule, about equal. Specimens found by Burdon at Royston were, according to Cholodkovsky's diagnosis, *Ch. viridis*, but there are no Larches there for the Alatae to migrate to! These obscurities emphasize the need for more workers in this particular branch of cecidology.

Chermes strobilobius presents an even more bizarre life-history. The **Fundatrices** are black in winter, and greenish in spring. They may be at once recognized by their position, being always seated *on* the spruce bud, never below it (Plate X., Fig. 1), by their long, straight hair in winter, and long, white, twisted hair in spring. They almost invariably attack buds on weak or damaged branches, and the resulting



STAGES IN THE LIFE HISTORY OF CHERMES STROBILOBIUS

gall is a small pale green thing, about the size of a pea, with a whitish, waxy bloom (Fig. 2). It ripens very early, and usually opens in the middle of June. The **Alatae** migrate to the Larch, and deposit their eggs on the needles. The resulting **Colonici** hibernate on the bark of the branches, and deposit numerous greenish-brown eggs at the base of the buds in spring. Fig. 3 shows a third-year Larch shoot at the end of March, with Colonici and their eggs, and Fig. 4 presents an enlarged view of one with its eggs; there is no wool. The generation which hatches from these eggs in May and June departs from the sequence observed in the life-cycle of *Ch. viridis*, and, instead of winged Sexuparae only, which migrate to the Spruce, we find that the generation usually splits into two parallel series—wingless insects known as **Exules** and the winged **Sexuparae**. The larval stages of both are spent on the Larch needles, which often bend at right angles at the point attacked. Figs. 5 and 6 show eggs of Exules and Sexuparae on bent Larch needles. The afflicted needles are often slightly swollen at the affected part (Fig. 5), and become yellow. The winged sexuparae (Figs. 9, 10) fly back to the Spruce and deposit their eggs on the needles. Fig. 7 depicts a Larch shoot with Colonici, Exules, and winged Sexuparae, some of the latter starting on their migration to the Spruce. The eggs are said to vary in colour according to the sex, the yellowish-green ones producing male, the reddish ones female, **sexuales**. The female deposits her single egg on the shoot, and this egg yields the Fundatrix. The wingless Exules remain on the Larch, and lay greenish-brown eggs on the needles. There may be two generations during the summer. Fig. 8 shows an Exule with its pupal skin on a Larch needle. With the approach of winter they withdraw to the branches to hibernate, and are then identical with the Colonici.

The double of *Ch. strobilobius* Kalt. is *Ch. lapponicus* Cholod., which in its life-cycle resembles *Ch. abietis*. The Fundatrices are seated on the bud, never below it, and differ from those of ***Ch. strobilobius*** in the larger size, more copious excretion of

wool, and lighter colour. They become reddish towards the end of egg-laying, and their eggs are dark green. I cannot separate the Alatae from those of *Ch. strobilobius.* They are so closely allied that we are, as Burdon remarks, "reduced to a sole difference in habit for distinction between the two species. If the Alatae migrate, the species is *Ch. strobilobius ;* if not, it is *Ch. lapponicus.*"

We have thus far considered four species, *Ch. abietis* and its double *Ch. viridis*, in which the Fundatrices are seated at the *base* of the bud; and *Ch. lapponicus*, with its double *Ch. strobilobius*, in which the Fundatrices are seated *on* the bud. There still remain *Ch. orientalis* Dreyfus and its double *Ch. sibiricus* Cholod., in which the Fundatrices are seated on the stem a little distance *below* the bud. Very little is known respecting *Ch. orientalis* and *Ch. sibiricus* in this country. Burdon observed the galls caused by one of them on the Oriental Spruce (*Picea orientalis*) at Cambridge in 1907, but failed to find the hibernating Fundatrix. My experience at Haslemere in 1909 was very similar. I found numerous galls on *Picea* sp. late in July, but as this gall opens very early, May and the first fortnight in June, the occupants had left. Curiously, I have since failed, after most careful examination, to find any Fundatrices and new galls on this tree.

Whether the six forms above alluded to are true species or merely varieties remains to be proved. According to Cholodkovsky, they are valid species; but, as Burdon suggests, possibly some of them may eventually be shown to be nothing more than biologic forms.

Certain Aphidae of the genus *Schizoneura* give rise to some very striking galls. *Schizoneura ulmi* attacks Elm leaves. The afflicted leaves curl downwards and inwards, forming a scroll gall of a pale yellow colour. These galls are not uncommon in summer and autumn in many districts. There are seven generations in the life-cycle of this Aphis. The wingless queen or Fundatrix is of variable colour. She attacks the young leaf, causing it to blister and curl,

and within the roll her numerous progeny go through their moults. The adults fly to other trees, and there deposit their remarkable progeny. Buckton* observes: "These young are born in the form of yellow ova, and might be almost mistaken for such, except from the existence of two black eyes which are sufficiently perceptible. The casting of a delicate membrane permits the disengagement of the limbs and the rapid growth of a golden-yellow pilose coat." The fourth and fifth generations are active wingless creatures, which live on the twigs and powder the leaves with wool. The sixth generation are winged insects, which differ from the early Alatae in their smaller size. They frequent the bark, and there give rise to the seventh generation, in which both sexes are present, the male being very diminutive. The female lays a single egg, which produces the hibernating Fundatrix.

The remarkable tumours or "cankers" not infrequently seen on Apple trees are always associated with *Myzoxylus laniger* (*Schizoneura lanigera*), the so-called "American blight." Descriptions of the insect and its life-history may be found in Miss Ormerod's "Manual" and other books on economic zoology. The structure and origin of the canker has been investigated by Dr. J. E. Blomfield. The deformities are produced on the roots as well as the stems and branches. The Aphidae do not attack the green terminal part of a twig, but select a spot near to the old wood, where the formation of a periderm is indicated by the reddish-brown tint. Great activity of the cambial region immediately takes place, and overgrowth results. The soft parenchymatous tissue splits in dry weather, and fungi enter, causing necrosis and ulceration, which the plant tries to heal by producing new cambial tissue. If this continues long, tumours attaining the size of a man's fist may arise. A striking example of the latter condition is shown in Plate XI., which depicts part of the branch of an Apple tree bearing thirteen spherical tumours, the smallest being about the size of a pea, the

* "British Aphides," vol. iii., pp. 98, 99.

largest 2 inches in diameter. The branch which bears these hypertrophies is only 1 foot in length and ½ inch in diameter. Blomfield does not think that mechanical irritation initiates the hypertrophy of the cambial cells, and leans to the view that it must be caused by a ferment from the salivary gland of the insect.*

The galls arising from the presence of *Tetraneura ulmi* are not infrequently found in association with those caused by *Schizoneura ulmi*, described above. They are, however, quite distinct. The gall of *T. ulmi* is a capsule which completely encloses the Aphis and her progeny. It begins as a blister, the edges of which rise upwards until they meet over the

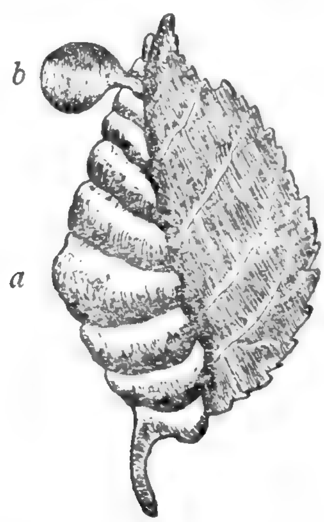
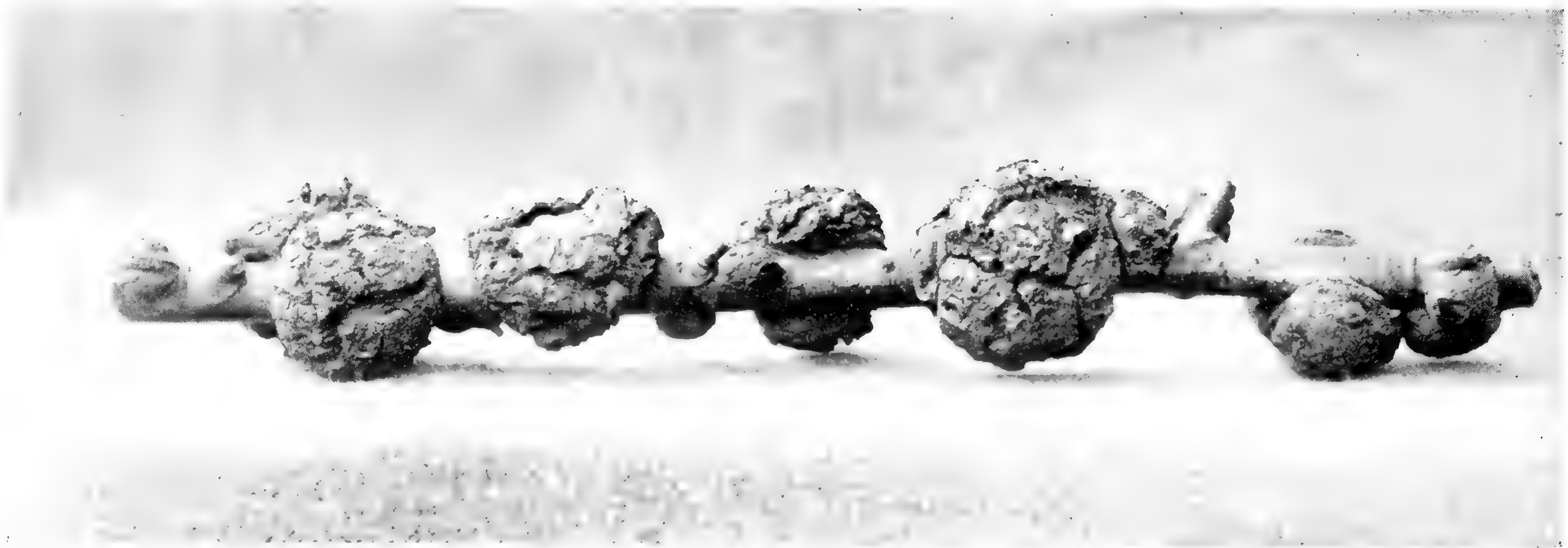


FIG. 21—ELM LEAF WITH SCROLL GALL (*a*) CAUSED BY *Schizoneura ulmi*; AND CAPSULAR GALL, (*b*) CAUSED BY *Tetraneura ulmi*. (1/2.)

insect. Buckton remarks that "the leaves, viewed from the under side, show oblong orifices or slits at the junction of the peduncle. These ventilating slits are partially closed by a dense fringe of jointed threads, which doubtless prevents the entrance of many a prying parasite. The cells were full of winged insects on the 20th of July." Within this pedunculated chamber the Aphis undergoes her four moults, and produces her young. The latter are blackish at first, becoming greenish after the first moult, and are provided with a white woolly coat on the abdominal parts. A fairly

* Brzezinski asserts that *Bacterium mali* is the cause of these tumours.

PLATE XI



PART OF A BRANCH FROM A CRAB-TREE (*Pyrus Malus*) BEARING NUMEROUS TUMOURS. AN APHIS (*Myzoxylus laniger*) AND A FUNGUS (*Nectria ditissima*) OCCUR IN CONNECTION WITH THESE CANKERS, AND IT WAS THOUGHT THAT THE LATTER CAUSED THEM. IT HAS BEEN ASSERTED RECENTLY, HOWEVER, THAT A BACTERIUM (*Bacterium mali*) INITIATES THESE OVERGROWTHS

large slit occurs at the base of the neck of the gall at the time when the insects are ready to emerge. An Elm leaf bearing the scroll gall (*a*) of *Schizoneura ulmi*, also the capsular gall (*b*) of *Tetraneura ulmi*, are shown on the preceding page.

Some very interesting galls are caused by Aphidae of the genus *Pemphigus* on the leaves and petioles of our native Poplars, also the Lombardy Poplar (*Populus fastigiata*). Three of these galls are shown in Plate XII.; all are in connexion with the Black Poplar (*Populus nigra*), the tree specially affected by these Aphides. Fig. 5 depicts the scroll galls of *Pemphigus affinis*, showing the early and green state at (*d*), and the later brilliantly tinted one at (*e*). The pear-shaped galls of *Pemphigus bursarius* are shown at Fig. 6 growing from buds. Fig. 7 depicts the apterous viviparous female, and Fig. 8 a pupa, both about five times the actual size. These galls may occur also on the petioles and leaves. On the former they are situated on the upper side of the groove, and the insects emerge by a small slit at a point remote from the petiole—that is, at the apex of the gall. The petiole is also attacked by *P. spirothecae*, and a very distinctive and curious spiral gall results. The edges of the grooved petiole swell up and arch over; at the same time the petiole becomes spirally twisted. The swollen edges meet, but do not fuse. When the limit of growth is reached, they contract and separate, leaving a spiral slit through which the insects emerge. Fig. 9 shows a petiole with the gall of *P. spirothecae*, about half the actual size, and Fig. 10 a magnified representation of the apterous viviparous female.

We must now pass on to a consideration of some galls caused by Psyllids. The **Psyllidae**, or springing plant-lice, are minute insects with three ocelli and 8- to 10-jointed thin antennae. They differ greatly in the early and adult stages, the legs and antennae varying in length and in the number of joints. There may be four or five moults. In the early stages of some species—for example, *Trioza rhamni*—the body has long, broad, and flat hairs, known as "wax hairs," which

change their form as growth progresses. A remarkable feature of these insects is the enormous amount of secretion from their bodies. In some it is solid, as in *Psylla buxi*, where it forms a very long string attached to the body; in others it is downy or waxy; and in not a few it takes the form of "honey dew," which is always so attractive to ants and wasps.

Psylla buxi attacks the apical shoots of the Box; the leaves become deformed and bent into a hemispherical gall resembling a cabbage in miniature. *Trioza rhamni* causes shallow depressions on the lower surface of Buckthorn leaves.

A well-known Psyllid gall is that caused by *Psyllopsis fraxini* on the leaves of the Common Ash. We found them in great abundance in June, 1910, in the large wood above Weston-super-Mare, and in the Ash plantations on the limestones in other parts of Somerset. Usually only one-half of the leaf is involved, generally towards the apex. The infected parts assume a light yellow tint, and are traversed by swollen reddish veins, presenting a pretty reticulated appearance. In Plate XII., Fig. 1 (*a*) shows a gall in an early state, (*b*) a mature gall, (*c*) an old and broken one. Figs. 2 to 4 show the Psyllid in various stages of development.

The only insect gall that I am acquainted with on our native Rushes is caused by the Psyllid *Livia juncorum*. It is very distinctive. At maturity it resembles a tassel, and is usually situated at the apex of the stem. It consists of a variable number of stunted green blades springing from the widened sheath of the shortened stem. The galls that are in the blade are yellowish, but those which catch the sunlight are beautifully tinted with red. They are not uncommon on various species of *Juncus* on the margins of large ponds in the southern counties—for instance, Frensham Pond, in Surrey.

We now come to the last family of the British gall-causing Homoptera—namely, the **Coccidae**. The minute insects which comprise this family are popularly known as scale-insects or mealy-bugs. All excrete matter which forms a

PSYLLID GALLS ON ASH LEAVES, AND APHIS GALLS ON POPLAR

scale in some species and a white powdery covering in others. They are mite-like at first; the female loses the power of locomotion later. The generations are usually similar; viviparous reproduction and parthenogenesis is the exception rather than the rule. The sexes are usually very different; the male is very minute. The *Coccidae* are very remarkable in the great differences exhibited in the post-embryonic development of the two sexes in the few forms in which it has been at all closely studied.

"When hatched from the egg the young Coccids are all similar, male and female being indistinguishable. A difference soon appears, with the result that the male, after passing through more than one pupal condition, appears as a winged insect. The female never becomes winged, but, if we may judge from the incomplete accounts we at present possess, her development varies much according to species. In some she retains the legs, antennae, and mouth-organs; in others she loses these parts, though retaining the original form in a general manner; while in a third (*Margarodes*) she becomes encysted, and apparently suffers an almost complete histolysis, reappearing after a long period (it is said it may be as much as seven years) in a considerably altered form" (Sharp). In Australia certain Coccids cause enormous galls on *Eucalyptus*, sometimes a foot in length. The galls caused by British species are all obscure. Perhaps the best known are the galls-pits in the bark of Oak twigs caused by the presence of *Asterodiaspis quercicola*. Growth takes places around the female, which remains fixed to one spot, causing pits about 2 mm. wide and 1 mm. deep. They may be found not uncommonly on scrub Oaks in summer.

Mytilaspis pomorum, a species of wide distribution in Europe, is said to cause tufts of little abnormal branches on a slightly swollen part of the stem of the Common Ling. Douglas mentions, amongst other habitats for this insect in Britain, "stem of Heather (Calluna)," but does not allude to the gall. It can scarcely be doubted, however, that *M. pomorum* does give rise to these galls on Heather in Britain as well as on

the Continent; the habits of any one species of insect are the same everywhere, though it is possible, as the Rev. E. N. Bloomfield has pointed out to me, that the insect may cause a gall on an allied plant, and in some cases on various plants, and the one it favours in Britain may be one on which it is not found on the Continent. There are several Continental records of homopterous galls on plants which find a place only in the alien flora of this country. These insects have been recorded as British, and it is possible they may have been introduced on the plants in question; but until we have certain evidence of their causing galls on them in Britain, it is advisable to omit them from the catalogue of British gall-causing insects.

Experimental Galls

Peyritsch, experimenting with *Aphidae* in 1888, produced modifications of the floral organs, chiefly swollen axis and chloranthy, in species of *Arabis*. The same observer recorded that *Trioza cerastii* H. Löw, a species not recorded as British, caused a rounded gall consisting of numerous imbricated leaves on the stem of *Cerastium glomeratum*.

Economic Notes

The order Homoptera includes some of the most troublesome of all pests. The rapidity of production, and the fact that its members feed throughout life easily, explain why the family *Aphidae* contains the worst offenders. Several are well-known gall-causers, and the majority that have been alluded to in this chapter often cause serious losses. Information concerning these and many others may be obtained in the leaflets issued by the Board of Agriculture, and in Miss Ormerod's "Manual." It may be mentioned here that a simple method of destroying *Aphidae* is to spray affected plants with a wash made of 10 pounds (or less) of soft soap dissolved in 100 gallons of soft water; the soap kills them by

blocking up the breathing pores. Six to eight pounds of quassia chips are usually added to the mixture in the case of honey-dew producing species.

Luckily for mankind, *Aphidae* are kept in check by an enormous number of insects. The little spotted beetles known as "ladybirds" and their larvae prey upon them, also the voracious larvae of the hover and lacewing flies. Various hymenopterous parasites of the family *Chalcididae* deposit their eggs in the bodies of *Aphides.* Ants, however, value them for their products, and carefully guard them. The passage of ants up and down the trunk of a tree is a certain indication that *Aphides* are present.

CHAPTER VII

GALLS CAUSED BY MITES (ACARI)

MITES and ticks are included in the order Acari. The systematic position of this order is in the class Arachnida, which also includes scorpions, spiders, and harvest spiders. Mites and ticks are creatures of such peculiar organization that they seem far removed from the other members of the Arachnida, but they appear to bear some affinities with the harvest spiders.

The order contains two groups, the typical mites and ticks (*Acarina*) and the worm-like group (*Vermiformia*). Gall-causers occur only in the latter group. In the *Acarina* the larva has at first only three pairs of legs, it acquires later the fourth pair; eyes are usually present. In the *Vermiformia* there are no eyes and no tracheae. In some species the adult has four pairs of three-jointed legs, but in the family which contains the gall-mites the third and fourth pair of legs are missing; the first and second are placed on the forepart of the body, which is long and furnished with bristles arranged more or less symmetrically.

The Vermiform mites are very minute, and are often overlooked in the absence of microscopic examination for them. The species known as *Eriophyes fraxini*, which is responsible for the curious fasciations of the flowers of the Common Ash, is one of the pigmies of this pigmy race; it is quite invisible to the unaided eye, and may be best seen by washing a gall in a little water and examining a drop of the fluid under a $\frac{1}{4}$-inch objective.

Mites are rarely found in some galls with which they are known to be associated, *e.g.*, the red, pimple-like galls on Sycamore leaves, and the nail-like galls so frequently seen on the leaves of the Lime. This may probably be explained to some extent by their migratory habits. There is sometimes great similarity in size and shape between certain galls caused by flies and mites. They may be distinguished easily, however, by macroscopic characters. Mite-galls always have a hole leading into them; those caused by gall-gnats have no such opening, the larva being completely enclosed.

The chief distinguishing feature of mite-galls is the felt of abnormal hairs which, with but few exceptions, covers the attacked part. These hairs arise from altered growth of the flat epidermal cells, which are stimulated, probably by a secretion from the mites, into outward growth. They assume various forms—in some galls they are quite simple and filiform, in others they are strongly clubbed at the apex, and resemble a miniature agaric. The pubescence is usually very dense, and the creatures are not easily distinguished, being so very minute, amidst the mass of tangled hairs in which they reside. They were quite overlooked by early botanists, who gave various names to the galls without being aware of the true cause of their production; for instance, the red pustules on the upper surface of Alder leaves were designated *Cephaloneon pustulatum* by Bremi. Within recent years the mites which infest the hairs received the name of *Eriophyes laevis* Nalepa. The flat and often conspicuously coloured patches of pubescence on leaves were supposed to be caused by fungi, and were assigned to various genera—*e.g.*, *Erineum* and *Phyllerium*. We may instance the rusty-brown patches so frequently seen on the under surface of Alder leaves. Persoon christened them *Erineum alneum*; about a century later Fockeu gave the name of *Eriophyes brevitarsus* to the inhabitants of these miniature forests. The study of gall-causing mites is difficult, because various other mites associate with them, reaping a harvest where they

have not sown. The greatest living authority on the *Vermiformia* is Dr. Alfred Nalepa, the distinguished Viennese zoologist. Notwithstanding his patient and long-continued investigations, the field of research is so vast that practically only a fragment of it has been explored.

There are about fifty species of British gall-causing mites; the great majority belong to the genus *Eriophyes*. Of the species belonging to the four other British genera, *Monochetus sulcatus* gives rise to pod-like galls on leaf buds of the Beech; *Epitrimerus trilobus* causes the leaf margins of the Common Elder to roll upwards, forming a pouch; *Tarsonemus spirifex* is probably responsible for the looped swellings sometimes seen on stems of the Mat Grass; *Phyllocoptes acericola* causes a slight swelling on the upper surface of Sycamore leaves, the depression on the underside being clothed with hairs; and *Phyllocoptes fraxini* attacks Ash leaves. The margins become tightly rolled towards the lower surface; the interior of the roll is lined with hairs.

We must now comment upon some galls caused by species of *Eriophyes*.

E. similis commonly galls Blackthorn leaves; the margin of the leaf becomes more or less swollen (Plate XXI., Fig. 1). An individual gall is pimple-like, light green at first, becoming red or brownish at maturity. The galls are usually present in great numbers, becoming confluent, when they considerably distort the leaves. They are abundant in June and July.

Another common mite-gall occurs on Hawthorn leaves, probably often escaping observation though its unattractive appearance; it is caused by *Eriophyes goniothorax*. Here, again, the margin is the part usually attacked; it becomes involute and slightly thickened; sometimes the incurvature extends to the midrib. The affected part is always a lighter tint than the rest of the leaf.

The radical leaves of the Great Knapweed are sometimes infested with *E. centaureae*, causing pustules, which are greenish at first (Plate XXI., Fig. 4), becoming violet-black

at maturity. They are usually present in great numbers, and project almost equally from both surfaces of the leaf. The aperture is in the centre of a depression in the convexity on the upper surface. I found these galls in great abundance on Berry Head, Brixham, in June, 1909; about the same time they were taken by the late Edward Connold at Hastings. They are not common, and had not, to my knowledge, been observed hitherto in Britain.

Yew buds are not infrequently attacked by *Eriophyes psilaspis*. Affected ones become swollen (Plate XXI., Fig. 9), attaining 8 mm. in diameter. They do not unfold, are often tinted with yellow, and minutely granulated. The mites are very numerous, and congregate between the scales. This gall was first noticed in Britain in the spring of 1875, when it occurred in great numbers in Yew hedges near London. It is frequent on trees and bushes that have been clipped.

Eriophyes viburni causes small red pustules (about 5 mm. in diameter) to appear on the upper surface of the leaves of the Mealy Guelder Rose (Plate XXI., Fig. 5). The pustules are usually coalescent, often occurring in such numbers as almost completely to cover the leaf, which, however, is never greatly deformed. These galls are covered with tufts of short, stiff hairs. The opening is on the lower surface, and is surrounded by a felt of hairs; the interior is lined with hairs, amidst which the mites may be found in hundreds. Various aspects of the gall under low magnification are shown in Plate XXI., Figs. 6 and 7. The Mealy Guelder Rose is frequent in the large wood on the hill to the north of Weston-super-Mare. A careful examination in June, 1910, revealed only two bushes afflicted with the mites. These were growing side by side, and the majority of their leaves, excepting the young ones, bore the characteristic galls in enormous numbers (Plate XXI., Fig. 5); closely adjacent bushes were quite free. The limitation of the mites to two bushes only, in a large wood containing hundreds of these bushes, is of great interest. The non-infection of the majority cannot be

explained by the theory of immunity. Mites lack wings, and, being feeble creatures, probably depend entirely on chance aid in dispersal. It is known that the Currant-bud mite assumes an erect position and waits an opportunity for "getting a lift." Does *Eriophyes viburni* adopt the same tactics? Its present distribution in the wood alluded to should be investigated by local cecidologists. The mite *Phyllocoptes oblongus* Nalepa is a commensal in this gall.

The bundles of small twiggy outgrowths not infrequently seen on the branches of various trees are known as "witches' brooms." They are caused in most cases by mites, but some are induced by parasitic fungi. They are particularly numerous on the Common Birch, and are most apparent in the leafless season, when they resemble birds'-nests. Plate XX. shows a Birch bearing numerous brooms caused by *Eriophyes rudis*. The majority of, if not all, the brooms on Birches in the south of England are caused by *E. rudis*, but it would appear that the fungus *Exoascus turgidus* is responsible in Scotland for these curious outgrowths. These galls exhibit the same discontinuous distribution as those of *E. viburni*; perhaps but one tree in a coppice bears them, whilst hundreds near by are totally exempt. The beginning of a "witch's broom" is a swollen bud. The axis of the shoot is seen to be pubescent in March, and yields mites in abundance late in the month if the weather is mild. The buds on afflicted shoots are shorter, more globose, and open earlier than normal ones. The attraction of sap to the spot causes the development of an enormous number of twigs, which grow from a core that increases slowly year by year. Some of the very large brooms occasionally seen on Birches must be of many years' duration. Some that I have had under observation for the past fourteen years at Haslemere are depicted in Plate XX., and are not very large. Mites are probably also responsible for the development of the more or less rounded bosses, usually from 4 to 6 inches in diameter, covered with buds, that frequently occur on the stems of these trees. They are

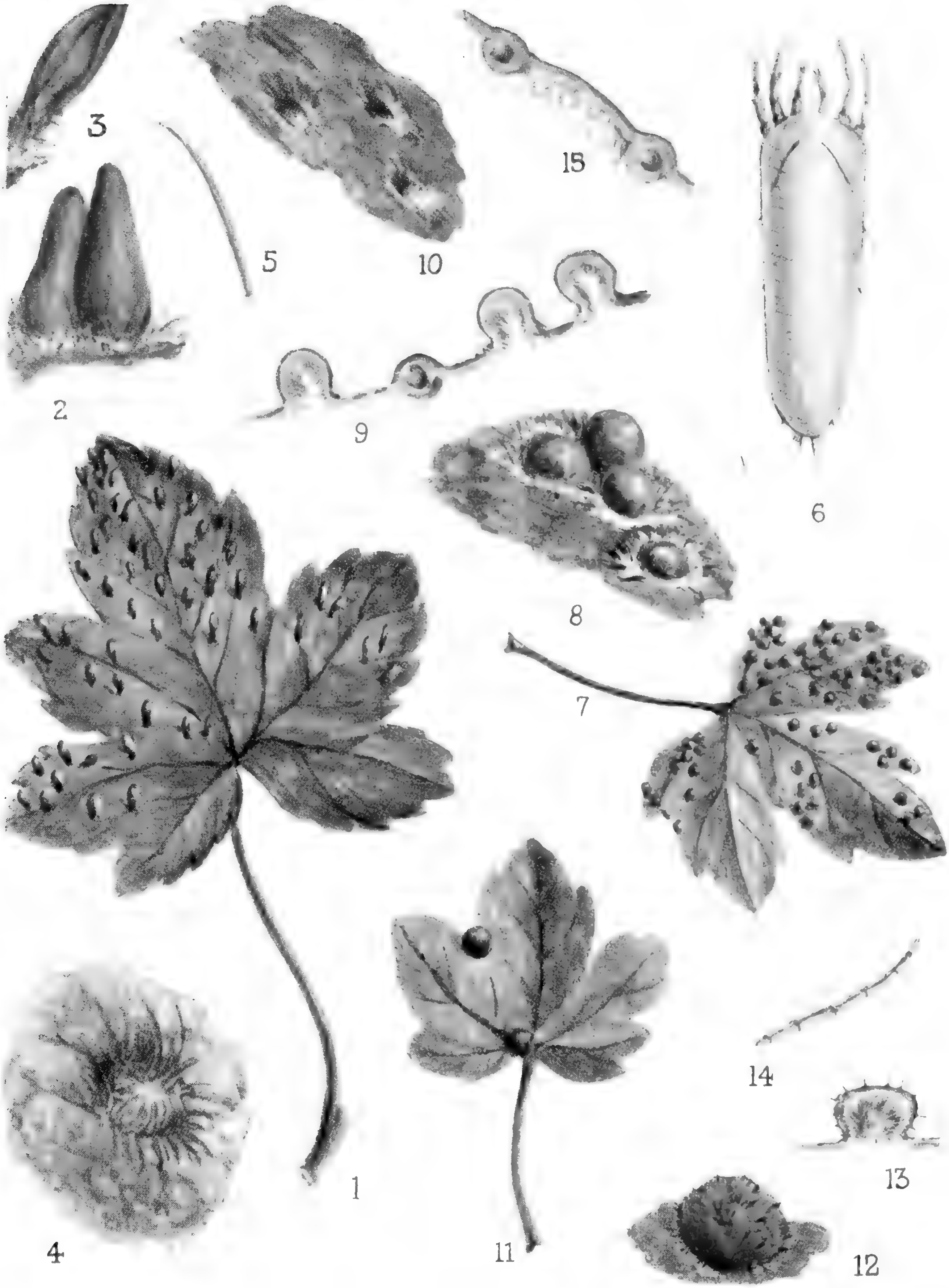
also said to be the cause of the dense masses of small twigs which almost completely cover the trunks of some Beech trees. A remarkable example is shown in Plate XIV.; the absence of twigs from the lower part of the trunk is probably due to rubbing by cattle.

The Sycamore leaf on Plate XIII., Fig. 1, is studded with the galls of *Eriophyes macrorrhynchus.* They are very common in June and July, often occurring in hundreds on a single leaf. The average diameter is 2 mm., the height 3 mm.; the shape is shown in Fig. 2, which gives a magnified view of two galls. Fig. 3 is a section of the same magnification, showing that the hairs within are more abundant towards the base. Fig. 4 is an enlarged view of the aperture of the gall, with its armature of hairs; and Fig. 5 a magnified hair, to show its unicellular character. Hairs are often present at the base of the gall on the upper surface of the leaf; a gall may occasionally be found on the lower surface. Mites occur but rarely in galls filled with hairs; hairs are always present at the orifice, and probably afford some protection to the inmates.

There is a splendid photograph of these growths in Connold's "Vegetable Galls," wherein they are ascribed to *Phyllocoptes acericola*, a mite which sometimes occurs in company with *E. macrorrhynchus.* The characteristic gall of *P. acericola*, however, is a very slight swelling on the upper surface of the leaf, with the corresponding depression on the lower one filled with a mass of swollen hairs. It is situated between the larger veins. Fig. 15 is a magnified section through two veins and the gall of *P. acericola* between them. Fig. 6 represents *E. macrorrhynchus* magnified 250 times. This mite also gives rise to the well-known red pimples often occurring in enormous numbers on Maple leaves. They appear in the latter part of May as minute specks, when they are noticeable only because of their light green tint; at maturity they assume a beautiful reddish-purple tint (Plate XIII., Fig. 7). They are spherical and usually densely gregarious. Fig. 8 shows three mature galls and a young one; Fig. 9 is

a section through three galls and one of the larger veins; Fig. 10 the orifices on the lower surface of the leaf (Figs. 8 to 10 are magnified). There is another common gall on Maple leaves caused by *Eriophyes macrochelus*. It is abundantly distinct from the preceding in its larger size and isolated habit (Figs. 11, 12, 13), and may also at once be distinguished by the pluricellular character of the hairs which line its interior (Fig. 14). The galls of both species may occur on one leaf, and leaves quite devoid of galls may often be found adjacent to infected ones. Several species of supposed *Phyllerium* have been observed on fossil Maple leaves.

At least three species of *Eriophyes* frequent Alder leaves in this country, causing familiar galls. In those resulting from the presence of *E. Nalepai* the pustules are hemispherical, about 3 mm. high, seated on the upper surface, always at the junction of the lateral veins and midrib, and arranged in pairs. They are glabrous, yellowish-green at first, becoming red or brown. Each pustule contains a cavity with a wide opening on to the lower surface of the leaf. The hairs are white or yellowish-brown; when viewed under the microscope they are seen to be of two kinds—one plural-celled, blunt-pointed, and thick-walled, usually much distorted and entangled; the other unicellular, very short and thick. The slight swellings on these leaves are caused by *Eriophyes brevitarsus*. In the early stages of growth the hairs lining the depressions on the lower surface are whitish; they become brown at maturity, and resemble, when viewed with a pocket-lens, minute crystals of Demerara sugar. Under the microscope the crystal-like bodies are seen to be the enormously swollen heads of the hairs. In the interstices between these growths the mites live in hundreds, browsing upon the "sugar" so generously provided for them by the plant. The busy colony is a most fascinating object of contemplation. It is difficult to realize that the remarkable alteration of epidermal cells, from their normally flattened shape to these peculiar club-shaped bodies, is



GALLS CAUSED BY MITES ON SYCAMORE AND MAPLE LEAVES

entirely due to the stimulus of the irritating presence of these minute creatures. Yet it is so. Were the mites not present upon the young leaves in spring, these hypertrophies would not arise. Not all the occupants are the true causers. *Epitremerus longitarsus* is a commensal therein. This felt-gall was quite misunderstood by the older botanists. Persoon thought it was of fungoid origin, and described the fungus under the name of *Erineum alneum*. I have received on more than one occasion Alder leaves bearing patches of this brown felt, with the request to name the fungus infesting them. The blunder is not an egregious one after all, for we often find patches on the leaves in autumn without even a solitary mite in occupancy. These growths are the summer residenccs of the mites, and they not infrequently quit them in early autumn, long before the supply of chlorophyll has been cut off from the leaf, or even much diminished.

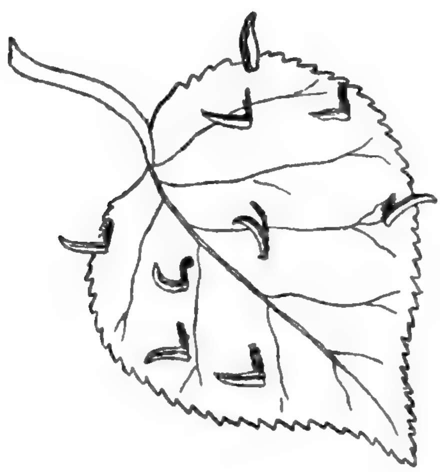
The last to be described of our trio of Alder-leaf mite-galls is perhaps the best known. It is caused by *Eriophyes laevis*. An individual gall is a little spherical pimple, about 2 mm. high, on the upper surface of the leaf. It is green at first, then various shades of yellow and brown, becoming either bright red or purple at maturity. These galls are usually densely gregarious (Plate XXI., Fig. 2), often occurring in hundreds on a single leaf. They are at their best in August, and not infrequently Alder bushes around ponds have the majority of their leaves attacked by the mites. A spray of leaves gathered from such a bush probably harbours *millions* of these mites! The orifice of the gall follows the rule in being on the under side of the leaf, and thus protected from rain. It is on a slight swelling surrounded by a circular canal; the interior of the gall is lined with cylindrical hairs, none being visible externally.

The patches of brown hairs often occurring on the axils of the larger veins of the leaf are also caused by an *Eriophyid*, a species at present without a name.

The influence of *Eriophyes macrotrichus* on Hornbeam leaves is very curious, and deserves comment here. The

secondary veins become considerably elongated, but their elongation is arrested by the rigid margin of the leaf; consequently, the leaf becomes contorted in a sinuous manner, forming a regular series of pleats and puckers.

The "nail-galls" of Lime leaves resemble tintacks driven through the leaf to the head from below. They are very common. If an inspection of their tenants is desired, they must be gathered in the early state, while green or yellowish-green. Sometimes the margin of a Lime leaf is rolled upwards, and the roll lined with a felt of hairs, conditions caused by the presence of the mite *Eriophyes tetratrichus*.



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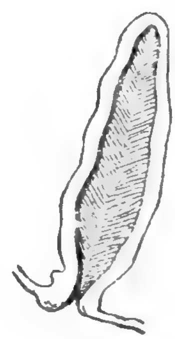

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FIG. 22—LIME LEAF WITH GALLS CAUSED BY THE PRESENCE OF *Eriophyes tiliae*. (1/2.)

FIG. 23—SECTION OF A GALL, SHOWING THE CAVITY LINED WITH HAIRS. (3/1.)

We often find Hawthorn leaves in summer-time with the margins of the segments more or less rolled inwards, sometimes to such an extent that they resemble a spike. They are easily recognizable by the discoloration of the attacked part; the roll is lined with hairs. This gall is caused by *Eriophyes goniothorax*. It is the *Erineum clandestinum* of Greville.

Allusion must now be made to some mite-galls of interest on account of their rarity in this country.

I was delighted to find in June, 1909, on the slopes of the headland to the south of the beautiful old fishing village of Brixham, the Common Bindweed bearing a pretty gall

hitherto unobserved in Britain. The leaf stalks, the midrib, and the larger lateral veins, were swollen, especially the midrib (Plate XXVIII.), forming a pouch with an extended opening on the upper surface. The hypertrophied parts were wrinkled or otherwise distorted, very pubescent within and without, and of a beautiful pinkish-red tint. The mite responsible for this interesting gall is *Eriophyes convolvuli*, hitherto recorded only from Central Europe. It may be noted that a very similar gall is caused on this plant by *Phyllocoptes convolvuli* Nalepa in Germany, France, and Italy. There is, however, no abnormal pubescence; the hypertrophy is less pronounced, of a greenish-yellow tint, never assuming the attractive hue of the other. This gall should be looked for on our southern coasts.

In the summer of 1910 I found on the Sheep's Bit at Haslemere another gall which is, I think, a new British record. The affected plant at first sight appeared to be merely an abnormally large one, with reddish and velvety involucral bracts. On closer examination I observed that the unopened buds on some of the stems were very hairy, also that a few flower heads were transformed into a bunch of small velvety leaves. The pubescence at once suggested the presence of mites, and they were quickly discovered upon microscopic examination. The Sheep's Bit mite is *Eriophyes enanthus*. Its gall has been recorded from Northern and Central Europe, also France and Italy.

Walnut leaves are sometimes galled by *Eriophyes tristratus*, var. *erineus*. A description of this gall is given in the catalogue. It was described by Persoon under the name of *Erineum juglandinum*. Fossil leaves of a species of Walnut have been found with galls resembling it.

Galls on Lichens

According to Zopf (1907), an *Eriophyid* causes scattered irregular swellings, containing a minute cavity, on the swollen thallus of the lichen *Ramalina Kullensis* Zopf. This

author thought that two varieties of lichens described by Nylander were probably nothing more than malformations caused by the presence of similar parasites. These lichens are recorded in Leighton's "Lichen Flora of Great Britain" (3rd edition) as *Ramalina scopulorum* Dicks., var. *incrassata* Nylander, with the thallus thick, rigid, tuberculoso-difformate, and *Ramalina cuspidata* Arch., var. *crassa* Del., with the thallus similarly deformed—the former from Harlech Castle, Wales, La Moye and Mont-Orgueil Castle, Jersey; the latter from rocks under Vale Castle, Guernsey. Miss A. Lorrain-Smith, F.L.S., informs me that she examined the specimens in the British Museum collections, just after the publication of Zopf's paper, and found fragments of mites, but, as far as she is aware, no one has identified the species. These interesting galls deserve to be better known and the causer identified.

Experimental Galls

Peyritsch published in 1888 some very interesting observations concerning experimental production of galls by placing mites (species unknown) on various plants. In *Valerianella* and *Valeriana* the deformities were chiefly of the floral organs; in several species the flowers were doubled, in others the leaves were rolled inwards, contorted, discoloured, and covered with the usual pubescence. In the Cruciferae the malformations also consisted of curious modifications and proliferations of the floral organs—*e.g.*, in *Myagrum perfoliatum* Linn. the flower was deformed and slightly double. Dr. Kerner's speculations concerning the possibility of the transmission of double flowers, when these have arisen through the influence of mites, are of great interest, and no apology is necessary for quoting them at length here. He noted in 1877 that some plants of *Veronica officinalis* produced double flowers in consequence of the settlement of mites upon them, and that adjacent plants without mites produced normal flowers. In the following year the mites attacked

the other plants, with the result that the majority of their flowers were double, as well as those of isolated plants on which he had placed mites. He remarks: "*Veronica officinalis* has only two stamens in each flower, and in the double flowers both these and the two carpels are changed into petals, so that of course we could not expect fruit and seeds from them. It would not be impossible, however, that flowers of other plant families, which are provided with a large number of stamens, might behave differently. It might happen, for example, that only *some* of the stamens would be changed into the petals by the gall-mites, and that the carpels would remain capable of fertilization. If on such plants fruits and seeds capable of germination should ripen, the latter might perhaps produce plants with completely and half double flowers. This would be explained by supposing that the alteration undergone by the protoplasm of the cells in the outer part of the flower had extended to the inner, especially to the ovules and seeds, and, further, to the plants proceeding from these seeds. I would, therefore, not undertake to state that the Stocks (*Matthiola annua* and *incana*), the Wallflower (*Cheiranthus cheiri*), the Pinks (*Dianthus caryophyllus*, *plumarius*, etc.), the Poppies (*Papaver Rhoeas* and *somniferum*), various Ranunculaceae (*Delphinium*, *Poeonia*, *Ranunculus*), and many other plants which have long been cultivated in gardens with semi-double flowers, and which produce such flowers when propagated by seeds, had not gained this characteristic in the first place by the influence of gall-mites."

Economic Notes

Two species of mites cause much damage in fruit gardens. The more troublesome is probably the Black Currant gall-mite, *Eriophyes ribis* Nalepa. It was observed in this country at least sixty years ago, but it is only within recent years that it has spread rapidly and become a serious pest. These mites shelter in the buds over winter and migrate in

spring, either by crawling or by fastening themselves to other creatures.

"During their migration period, which is from the middle of May to the middle of June, they exhibit curious methods of locomotion; the four short anterior legs are ill-adapted for walking, and yet they continually crawl about at a rate of twelve to fifteen times their own length in a minute. But this only takes them from bud to bud at the farthest; they get carried farther afield by passing insects and spiders, to which they adhere first by the stickiness of their bodies, and then by curling round a hair or antenna in a worm-like fashion, and holding on tenaciously. This can be shown by lightly touching an open infested bud with a fine camel's-hair brush, when the little white creatures will be found wriggling among the bristles, yet holding on in a determined manner. Their third method of getting about the world is the most interesting. If one watches a community of these mites in a bud under a microscope, one sees them continually standing up on their tails, waving the front legs agitatedly; then they suddenly disappear, and at first it is hard to imagine what has happened precisely. The disappearance is not so accidental as it seems; the animals are, in fact, leaping! The two tail bristles act as springs, and the mite covers about sixteen or twenty times its own length at a jump. It is always seen that after standing upright, waiting for a friendly insect to carry it off on its unsuspecting body, the mite ceases to wave its legs, remains rigid for a moment, and then launches itself forth, torpedo-like, into space. It is an entertaining spectacle to watch, for occasionally by retaining too firm a hold on the bud, the leap is rendered abortive, and the mite simply falls backwards with considerable impetus instead of making a clear jump. It is a suggestive fact that while the mites remain upright for minutes in the still air of a room, yet they can be induced to leap at once by blowing upon them. It seems, therefore, that they first try to get an obliging insect to carry them away, and, failing this, take advantage of a puff of air to

BEECH (*Fagus sylvatica*) WITH DENSE TWIGGY OUTGROWTHS SEATED ON SWOLLEN PARTS OF THE TRUNK AND LARGER BRANCHES. THEY ARE SUPPOSED TO HAVE BEEN CAUSED BY MITES (*Eriophyes*). THE IMMUNITY OF THE LOWER PART OF THE TRUNK IS PROBABLY DUE TO CATTLE RUBBING AGAINST IT

make their blind leap. Perhaps the mite succeeds in 'boarding' a passing insect which hovers near enough to fan it by the beating of its wings."*

Attacked buds may be at once recognized by their swollen and distorted appearance. The life-history of this mite has been fully investigated by Embleton, Collinge, Warburton, and other economic zoologists. A summary of their observations, together with preventive and remedial measures, may be consulted in Leaflet No. 1, published by the Board of Agriculture and Fisheries.

The Pear-leaf blister mite, *Eriophyes pyri* Nalepa, is also on the increase in this country. It causes raised greenish or red patches or blisters on the leaves, and sometimes on the fruitlets. It is a very minute species, quite invisible to the unaided eye. It passes the winter under the outer scales of the buds on young shoots. "It does not appear as an epidemic. Trees often remain unattacked in a garden, though in close proximity to badly infested trees." For particulars concerning treatment of this pest, see Leaflet No. 239, Board of Agriculture. This mite attacks various other rosaceous plants, such as the Apple, Service tree, Mountain Ash, and the rare *Cotoneaster vulgaris*.

On the Continent *Eriophyes Kerneri* Nalepa attacks various species of *Gentiana*; in all cases malformation and discoloration of the floral organs, often with "doubling," result, and the inflorescence of many Labiate plants is reduced and covered with a velvety pile under the influence of various mites, notably *E. Thomasi*, which infests many species.

Theobald, in his first Report of economic zoology (1903), alludes to a phytoptid disease in violets, causing the leaves to curl tightly over at each side and become greatly deformed. The mites were green, and large enough to be seen easily with a hand-lens. Specimens were sent to Dr. Nalepa, who considered it to be a hitherto unrecognized species. He described it under the name of *Eriophyes violae*.

* Alice L. Embleton, *Knowledge*, September, 1905, p. 234.

CHAPTER VIII

EELWORM GALLS (NEMATODA)

THE eelworms are comprised in the family *Anguillulidae*, belonging to the order *Nematoda*, or threadworms. It would promote the happiness of the human race if these creatures were non-existent, for amongst them are some of the most dreaded of human parasites. Those with which we are concerned live a parasitic life in plants, causing remarkable nodosities and tumours.

Eelworms are very minute, and cannot be seen well without the aid of a microscope, the adult in many cases being only 1 mm. long. The shape is that of an eel. The mouth has a sharply pointed spine, which is used for boring into plants. The ova are hatched within the body of the female; with growth they distend the skin until it becomes a mere sac. Eventually the parent dies, and the young are liberated by the rupture of the sac. They attain maturity, on an average, in thirty days. In the case of *Tylenchus devastatrix*, the larvae bore into the rootlets and become stationary. The adult female emerges from the plant, and is joined by the larger male, which bores its way out later. After fertilization the female degenerates, and at last is nothing more than a broad pouch containing ova and larvae; the majority of the ova hatch out within the body of the parent. There are six or seven generations in one year.

There are ten species of eelworms in this country, belonging to three genera:

Aphelenchus fragariae Ritz. Bos, on cultivated Strawberries.

Aphelenchus Ormerodis Ritz. Bos, also on Strawberries.
Hererodera radicicola Greeff, on Cucumbers, Tomatoes, Beet, and Clover.
Heterodera Schachtii Schmidt, on Beet, Hops, and various Crucifers.
Tylenchus Davainii Bastian, on Mosses.
Tylenchus devastatrix Kühn, on Rye, Beans, Oats, Wheat, Clover, Hops, and Hyacinths.
Tylenchus fucicola De Man, on Algae.
Tylenchus graminis Hardy, on Grasses.
Tylenchus millefolii F. Löw, on Milfoil.
Tylenchus tritici Roffredi, on Grasses and Wheat.

Aphelenchus fragariae causes remarkable enlargement and fasciation of the stems of the Strawberry; the entire plant is sometimes modified, and resembles a cauliflower. The leaves are more or less deformed, usually with one lobe instead of three. The worms swarm in the tissues, and may be found from April to September.

Aphelenchus Ormerodis also attacks the Strawberry, giving rise to galls which superficially resemble those caused by *A. fragariae*, but the affected stems are white, the leaves yellowish, and the worms live between the sheath and the stem.

Heterodera radicicola causes nodular swellings on the stem of the Common Couch Grass, also on Swede, Tomato, Cucumber, and other cultivated plants. Miss Ormerod first reported the occurrence of this pest, known as the "root-knot" eelworm, in Britain. It causes swellings or "knots" up to 6 mm. in diameter on the rootlets, and larger hypertrophies on the thicker roots.

Heterodera Schachtii causes lateral swellings on the slender root-fibres of the Cabbage, Turnip, and Charlock, and also does much damage to Beet. Its life-history has been investigated by Kühn. The female may be found attached to the rootlets. At her death 300 or more ova are liberated, which at once attack neighbouring rootlets, and give rise to nodular swellings thereon.

Tylenchus Davainii causes galls on Mosses; usually the terminal internodes remain closed, and the bunch of leaves forms a terminal artichoke-like gall. Dixon, in 1905, reported its occurrence in *Eurhynchium Swartzi* Curnow, and also recorded that *Thamnium* (*Porotrichum*) *alopecurum* Linn., bears galls caused by an unknown species of *Tylenchus*. He considered that galls of this nature appear to be very uncommon on Mosses—as he rarely came across them among the many thousands of specimens that passed through his hands in twenty years or more. Mr. W. E. Nicholson, however, has informed me quite recently that in his experience such galls are not very uncommon in this country. He kindly sent me some *Hypnum cupressiforme* gathered

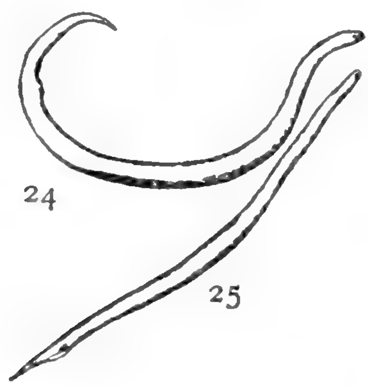

FIG. 24—*Tylenchus Davainii* Bastian. Female. (32/1.)
FIG. 25—*Tylenchus Davainii*. Male. (32/1.)

on the Downs near Lewes which contained eelworms, apparently *Tylenchus Davainii*, in large numbers. The galls were terminal, each about 2 mm. long. Nicholson thinks there can be little doubt that these galls are often overlooked. "On the Hypnum they might easily be passed over. They affect the mosses prejudicially, and they are consequently unlikely to be found on specimens gathered for herbarium purposes." He also noted the occurrence of Nematode galls on the hepatic *Harpanthus scutatus* received from West Inverness. Schiffner has recorded the occurrence of these eelworms on many Mosses on the Continent. There are also Continental records of hepatics attacked by eelworms, presumably this species.

Tylenchus devastatrix attacks various Clovers, causing arrest of development. The internodes are shortened and thickened, and the leaves deformed, with involute margins. It also attacks the Buckwheat, causing thickening of the stems, shortening of the internodes, and enlargement of the leaves. It causes bulbous swellings at the base of the stem of the Sweet Vernal Grass, Shepherd's Purse, and other wild plants. According to Connold, it is responsible for the deformed shoots and bulbous swellings on the lower part of

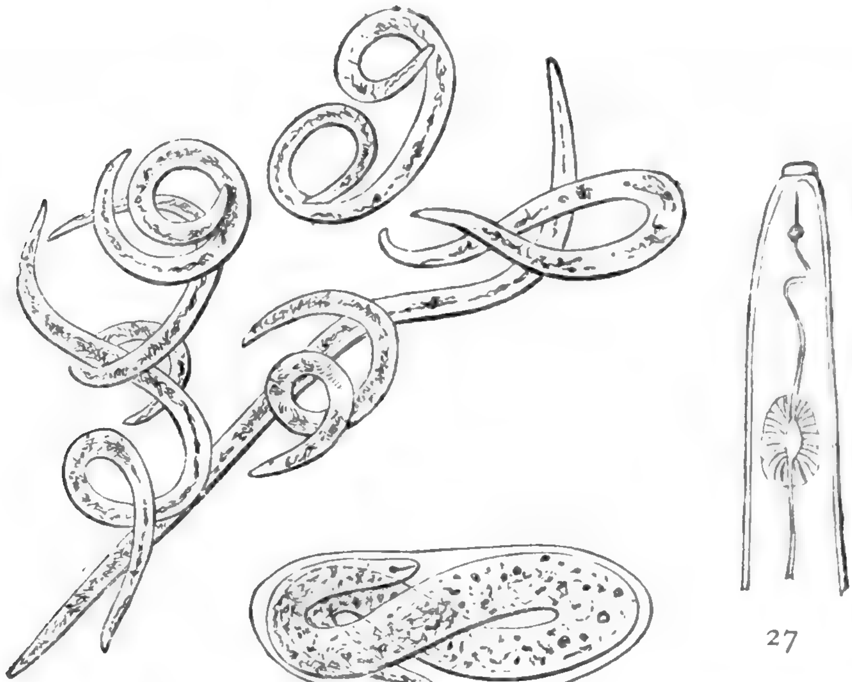

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FIG. 26—STEM EELWORMS (*Tylenchus devastatrix*). (Greatly magnified.)
FIG. 27—ANTERIOR PORTION OF A FEMALE, SHOWING THE MOUTH-SPEAR. (440/1.)
FIG. 28—EMBRYO IN EGG. (Greatly magnified.)

From figures by Dr. J. Ritzema Bos. Reproduced from Miss Eleanor Ormerod's "Manual of Injurious Insects," by permission of Messrs. West, Newman and Co.

the stem of the Wild Teasel. Houard attributes the galls on the Teasel to a *Tylenchus*, but leaves the species in doubt. I think I have seen it alluded to as *Tylenchus dipsaci*, but cannot find the reference. In *T. devastatrix* there is but one generation annually. Each female produces from 600 to 1,000 ova. Miss Ormerod observes that "the exceeding

slenderness of their eel-like shape can hardly be conveyed by statement of measurement, but when magnified 200 times, so that they appear a little more than 8 inches in length, their greatest magnified width hardly exceeds $\frac{1}{4}$ inch." Ova kept dry for six months will produce young, and young eelworms can survive two years' drought.

Tylenchus fucicola attacks Seaweeds. It causes oblong swellings of the thallus with internal cavities in *Ascophyllum nodosum* Le Jolis. It is also said to infest *Furcellaria fastigiata* Lamouroux. See papers by Barton referred to in the Bibliography. A species of *Tylenchus*, *fucicola* (?), infests *Chrondus crispus* Stackhouse, and *Rhodymenia palmata* Greville. Mr. A. D. Cotton, F.L.S., informs me that he very frequently finds galls on *Rhodymenia*, but has failed to discover eelworms in them. "It appears to me likely that the wart-like swellings on *Rhodymenia* may sometimes be produced by some other cause. I have also found galls not infrequently on *Ceramium rubrum*, but am not aware that anyone has explained their origin and character."

Tylenchus graminis causes minute oval or elongated, dark green or blackish pustules on the under surface of leaves in the Sheep's Fescue Grass.

Tylenchus millefolii causes very marked distortion of the entire plant in the Common Milfoil (Plate XV.). The hypertrophy consists of globular growths about the size of a hemp-seed, solitary or coalescent, yellowish-green at first, becoming brown. Each swelling contains numerous worms. These galls may be found throughout the summer and autumn, but are by no means common. Our illustration is from Plate XCVII. in Connold's "Vegetable Galls," wherein these galls are unfortunately ascribed to the presence of the larvae of the dipteron *Rhopalomyia millefoliae*.

Tylenchus tritici deforms the Marsh Bent Grass, causing elongated swellings about 5 mm. by 3 mm. at the base of the leaf, and globular growths about 1 to 5 mm. in diameter on the panicle. These hypertrophies are yellowish at first, becoming red or purple at maturity.

LEAVES OF THE COMMON MILFOIL (*Achillea Millefolium*) GALLED BY EELWORMS, *Tylenchus millefolii*

This eelworm also attacks Wheat, giving rise to roundish, growths resembling purplish or dark-coloured peppercorns in the ear, but it rarely occurs in sufficient numbers to be a serious pest. Miss Ormerod remarks: "The figures [reproduced below] give the mass of worms in a cockle gall, and also the worms just escaping from the eggs, all greatly magnified. It is difficult to convey any exact likeness of the wormlet itself at this size on wood, but the figure gives the general shape, and the upper end shows moderately the spear or proboscis in the mouth-end, though not its three-lobed base; also the rounded muscular swelling just below

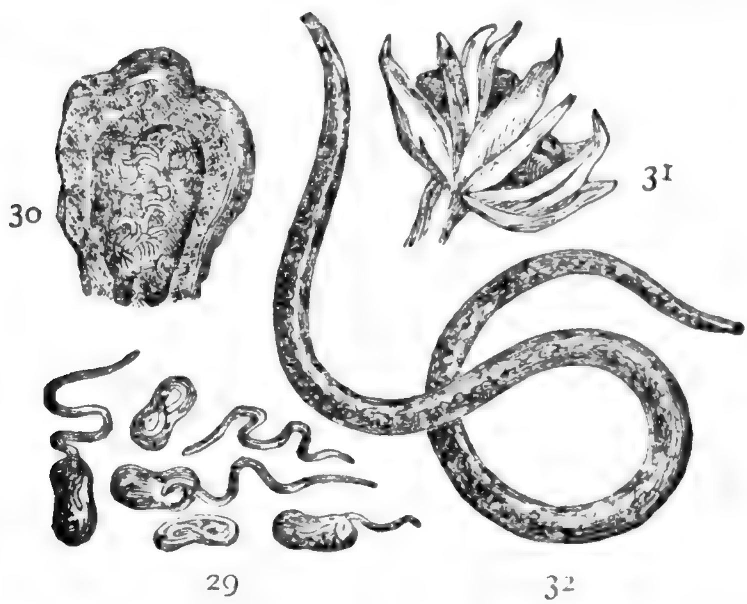


FIG. 29—WORMLETS OF *Tylenchus tritici* ESCAPING FROM EGGS.
FIG. 30—SECTION OF A COCKLE GALL WITH WORMLETS INSIDE. After Bauer's figures. (Much magnified.)
FIG. 31—SPIKELET OF WHEAT WITH GALLS. (Magnified.)
FIG. 32—*Tylenchus tritici*. WORMLET. (Greatly magnified; natural length about ¼ inch.)

Reproduced, by permission of Messrs. West, Newman and Co., from Miss Ormerod's "Manual of Injurious Insects."

which is one of the characteristics of this species, and the coarse fat granules in the intestine. The colour is yellowish-white, and the largest wormlets are from $\frac{1}{7}$ to even $\frac{1}{4}$ inch in length." Dr. Bastian noted that this eelworm may remain dormant for twenty-seven years, and again resume its wonted activity!

Professor Trail, in 1883, recorded the occurrence of *Tylenchus* galls on the Mouse-ear Hawkweed. The flower head was swollen, the stalk contorted and coiled on its axis. The species of eelworm responsible for these malformations is unknown; Connold designated it *Tylenchus hieracii,* but did not describe it.

Continental Eelworm Galls

In addition to the ten species indicated above, Houard describes in " Zoocécidies des Plantes d'Europe " six others that are gall-causers on the Continent. I am not aware that they have been observed in Britain, but some allusion to their galls seems desirable, as it is quite likely that all will be found to occur in this country.

Tylenchus Haversteini Kühn deforms the entire plant in *Medicago sativa.* The shoots remain closed, and are four times in excess of the normal thickness; they are also contorted and carry deformed leaves which are often transformed into complete scales (No. 3,516).

Tylenchus agrostidis Steinb. attacks various grasses of the genus *Agrostis*, causing the ovary to become elongated and tinted violet, and the glumes hypertrophied (No. 185, etc.).

Tylenchus hordei Schöyen gives rise to nodosities on the top of the radical root in *Elymus arenarius* Linn. (No. 350).

A species of *Tylenchus*, probably *T. hyacinthi* Prillieux, causes yellow spots on the leaves of a *Eucharis.* The spots become brown later, and there are clearly defined depressions on the lower surface (No. 433).

Tylenchus nivalis Kühn causes swellings on the stem and leaves of *Leontopolium* (*Gnaphalium*) *alpinum* (No. 5594).

Tylenchus phalaridis Steinb. attacks *Phleum pratense.* The glume is elongated, thickened, enrolled like a horn around the pistil (5 to 7 mm.), and of a yellowish tint. The ovary acquires the shape of a cylinder or spindle, and becomes yellowish-red or dull purplish-brown. The stamens are abortive (No. 179).

Economic Notes

It will be apparent from what has been written that the majority of gall-causing eelworms are troublesome pests; there is, moreover, always the possibility that species now infesting plants of little economic importance may establish themselves upon cultivated ones.

Worthington G. Smith recorded in the *Gardener's Chronicle*, 1886, vol. xxv., p. 41, the presence of little black spherical galls on the leaves of an *Odontoglossum*, which were caused by an eelworm.

Miss Ormerod, in 1891, observed galls on *Vicia Faba* Linn. caused by *Tylenchus devastatrix*. The stem is shortened and bears pronounced irregular swellings.

There are numerous Continental records of galls on members of the family *Liliaceae* caused by *Tylenchus devastatrix*. The evidences of attack are slight in many cases, but there is undoubted hypertrophy and consequent weakening of the plant.

Heterodera radicicola does much mischief on the Continent amongst cultivated varieties of *Clematis* and various *Rubiaceae* (notably *Gardenia*, *Coffea*, *Ixora*, and *Hamiltonia*), causing nodosities to arise on the roots.

For detailed particulars concerning the stem eelworm (*T. devastatrix*) and the Wheat eelworm (*T. tritici*), the reader should consult the second edition of Miss Ormerod's "Manual of Injurious Insects," and Leaflets 46 and 75 issued by the Board of Agriculture.

CHAPTER IX

GALLS CAUSED BY FUNGI AND MYCETOZOA

FUNGI are plants without a system of true tissues and without chlorophyll; the tissues are replaced by intertwining threads known as "hyphae." Oxygen is absorbed, and carbon dioxide is given off. The order is a very large one, comprising minute species known popularly under such terms as rust, smut, mould, and mildew, also the larger species, often spoken of as mushrooms and toadstools. The majority may be arranged under two headings, saprophytes and parasites. There are some intermediate forms. Certain saprophytic fungi may become true parasites. Saprophytic fungi flourish on dead organic matter, such as rotting wood, leaves, etc. Parasitic fungi feed on living organic matter, either plant or animal; many that occur on plants give rise to gall structures.

A parasitic fungus lives at the expense of its host as a rule, and confers no benefit in return, but many instances may be adduced in which a kind of give-and-take arrangement exists between host and parasite; such is known as symbiosis or mutualism. It may be seen in all lichens, a lichen being a composite plant, made up of a fungus and an alga, the latter the host, the former its parasite.

In some cases symbiosis favours vigorous growth and the production of more seeds than in the case of plants not affected by the parasitic fungus—*e.g.*, the hyphae which occur in *Lolium temulentum* and other grasses of the same genus. Spherical tumours occur on the root-fibres of many leguminous plants—*e.g.*, the Bird's-foot Trefoil and

Lady's Fingers. They contain bacteria-like organisms, and are regarded by some authorities as examples of symbiosis rather than true parasitism.

The rootlets of trees belonging to the *Cupuliferae* are often invested with hyphae known as *Mycorrhiza*. They are usually seen in plants grown in soil where humus is abundant, and would seem to be determined largely by the rate of transpiration. Mycorrhiza are usually found in plants with slow transpiration current, and some give rise to definite gall-like structures on the roots and rootlets.

The peculiar root tubercles on the Common Alder are shown in Plate XVI., Fig. 4. They are not uncommon on both large and small plants. They were first described in 1829 by Meyen, who considered them "pseudomorphosed roots." At one time they were classed by Woronin with the Mycetozoa under the name of *Schinzia alni*. According to the latest view, they result from the presence of a hyphomycete, *Frankiella alni* (Wor.) René Maire. Hiltner proved experimentally, in 1896, that these tubercles enabled the plant to assimilate the free nitrogen of the air by a process resembling that which occurs in leguminous plants, and showed that Alder plants can grow without tubercles if nitrogen is present in the soil, that the production of tubercles is hindered if nitrogen is present in abundance, and that calcium nitrate stopped their growth entirely. The tubercle masses often attain large dimensions. An old woodman on Sir Jonathan Hutchinson's estate at Inval, Haslemere, procured me some roots bearing numerous masses, each 3 inches in diameter.

Tubercle masses also occur on the roots of the Bog Myrtle. They differ in some important particulars from those of the Alder, and though at present the fungus held to be responsible for them is known as *Frankiella Brunchorstii* (Möller) René Maire, it will probably be placed eventually in a separate genus. Shibata placed it under *Actinomyces*; and Pecklo, in 1909, claimed to have isolated an actinomyces-like fungus from the tubercles, which is said to be

the only recorded instance of actinomycosis amongst plants. The masses of tubercles vary in size from that of a pea to a small walnut, but are usually never so large nor so abundant as those of the Alder. A single tubercle is a root-like growth, branching di- or trichotomously after attaining about 2 mm. in length, each tip sending out a thread-like structure, sometimes 3 cm. long, much resembling an ordinary rootlet, but tapering towards the tip. It is at first greyish-pink, then flesh colour, becoming dark brown when exposed to the air; sometimes the tubercles are quite black when very old. Mr. William Herridge observed these tubercle masses in abundance on the roots of Bog Myrtle in the clay-pits at Newton Abbot in 1910, and they are probably of frequent occurrence on this plant.

Fungi that cause reduction in size of the afflicted plants, or abortion of certain organs, are termed *Atrophytes*. With such the cecidologist is not concerned, except in a few instances in which the dwarfing is accompanied with minute gall-like excrescences on various parts of the plant, as may be seen in the case of Dandelion plants attacked by *Synchytrium taraxaci*. Under the influence of the parasite the dwarfed plants produce minute pustular galls on the leaves and involucres.

Fungi causing enlargement of the entire plant, or hypertrophy of certain organs only, are termed *Hypertrophytes*. They may be either autoecious, going through the life-cycle on a single host plant, or heteroecious, growing on different host plants during the various periods of the life-cycle.

Amongst the most remarkable of hypertrophies caused by fungi on leaves are the cherry-like structures which appear in July on the under surface of the leaves of *Rhododendron ferrugineum*, *hirsutum*, and *Wilsonii*, induced by *Exobasidium rhododendri*. The gall is a bullate excrescence, sometimes attaining the size of a Walnut, pale at first, becoming reddish and shining. It is known as the "Alpine Rose Apple"; it superficially resembles the "Cherry gall" of the Oak leaf, but is sweet. This large structure is connected with the

GALLS CAUSED BY FUNGI ON NETTLE AND GRASS STEMS, AND ALDER ROOTS; AND ON THE GERMANDER SPEEDWELL BY ONE OF THE MYCETOZOA

leaf by a narrow band, never exceeding 2 mm. in width, and the leaf is seldom distorted. These galls also occur on the stems and petioles.

Coleosporium senecionis is a typical example of a heteroecious fungus. Its aecidiospores are produced on the needles and young branches of the Scots Pine in May and June; the perennial mycelium causes pronounced fusiform swellings on the branch. In this stage it is known as *Peridermium pini*. The spores are carried by wind-currents to the Groundsel and to various Ragworts (*Senecio viscosus, sylvaticus,* and *Jacobaea*), and, germinating thereon, enter the tissues, and give rise throughout the year to uredospores and teleutospores, which appear in orange-coloured pustules on the leaves.

Another interesting heteroecious fungus gall-causer infests the Common Juniper. Juniper bushes in April and May not infrequently have large fusiform swellings on the branches, from which project compressed, elongated, pale orange bodies, 10 to 12 cm. long, which are firm and horny at first, becoming gelatinous. These bodies contain the dark yellow teleutospores of *Gymnosporangium clavariaeforme* (Plate XIX.). These spores are carried to Hawthorn bushes, and, alighting on a damp leaf or other growing part, germinate and enter the tissues. In about a month's time the spores (aecidiospores) of the second form of the fungus appear. These are carried back by wind, insects, or other agency, to the Juniper bushes, where they germinate, obtain entrance, and ultimately give rise to the teleutospores. The mycelium is perennial in the branches.

In the "witches' brooms," the dense masses of twigs seen on the branches of many trees, there is a suggestion of symbiosis. The parasite stimulates growth at the point of infection. The branches of the "broom" are more or less erect; its leaves are usually reduced in size, often lack chlorophyll, and the fruit-bodies ("cluster cups") of the fungus appear on them. We have already observed that the "witches' brooms" so frequently seen on the Birch often

result from the stimulus afforded by mites. Whatever the cause, once the growth is initiated, it may continue long after its cause has vanished, and these growths sometimes attain enormous dimensions. In the south of England the majority of the "brooms" on the Birch appear to be caused by mites. Worthington Smith has observed the fungus *Exoascus turgidus* in connexion with these growths on Birches in Scotland.

The "witches' brooms" on the Silver Firs (*Abies pectinata*, etc.) are caused by the fungus at one time known as *Peridermium elatinum*, the teleutospore form of which occurs on Chickweeds (*Cerastium*); it is the *Melampsora cerastii*. The mycelium is perennial in the bark, cambium, and stem wood, causing excessive localized hypertrophy. From the top of the fusiform swelling the twigs grow almost vertically upwards. Plate XVII. shows a dead branch bearing an old "broom"; such may be commonly found beneath trees afflicted by this fungus. The leaves on these twigs are smaller and arranged in a spiral manner; the orange pustules containing the spores of the fungus appear on them. These "brooms" are never so dense as those which occur on the Birch. The majority of "brooms" produce atrophied leaves only, but in some cases the leaves are normal, and even flowers are produced on the twigs. A "witch's broom" from a Larch was brought to the Haslemere Museum in 1905. The twigs formed a compact mass; upon the outermost well-grown leaves were present; there were also male and female flowers, and near the centre were many old cones that had not been shed. No trace of a parasite, either fungus or insect, could be discerned. The structure was of enormous size and weight, and probably had lived through two decades. Connold alludes to a "broom" on the Horse Chestnut; similar growths occur on Oak, Ash, Beech, Hazel, Blackthorn, etc.

The somewhat rare phenomenon of metamorphosis of the floral leaves is seen in an extreme form in the elongated, thin, and twisted purple-red lobes which occasionally take

A DEAD BRANCH FROM A SPRUCE (*Picea Menziesii*) WITH A PRONOUNCED FUSIFORM SWELLING BEARING A "WITCHES-BROOM" OF ERECT TWIGS. THE CONDITIONS HERE SHEWN RESULT FROM THE PRESENCE OF THE FUNGUS *Peridermium elatinum*

the place of bracts in pistillate flowers of the Common Alder. These peculiar galls result from the presence of *Exoascus alnitorquus*; they are sometimes 30 mm. long, and as many as ten small ones may occur on a single catkin. They may be found from June to October, but are rare in Britain. Alder trees abound at Haslemere, but I have never succeeded in finding the galls in this district.

In the latter part of May and throughout June Nettles afflicted with the aecidial stage of *Puccinia caricis* are frequently met with. The gall which arises is very noticeable; the condition is well shown in Plate XVI., Fig. 2. The stem becomes greatly swollen and bent; immersed in the swollen tissue are the bodies (pseudoperidia) containing the

FIG. 33—FEMALE CATKINS OF *Alnus glutinosa*, THE UPPER GALLED BY *Exoascus alnitorquus*. 1/2.

orange-yellow aecidiospores. The fungus also fruits on the leaves, forming yellow spots. It is heteroecious, and the aecidial stage is known under the name of *Aecidium urticae*. The aecidiospores are carried to various Sedges, on which the teleutospores are produced from July to April.

On the same plate (Fig. 3) may be seen grass stems attacked by the "Reed Mace" fungus, *Epichloe typhina*. Afflicted plants do not flower, and growth is seldom prolonged above the galled part, which is usually the upper leaf sheath. Upon its first appearance on the stem the fungus is a thin whitish crust; it becomes yellow later, and is then studded with the mouths of the perithecia immersed in the

swollen part. The perithecia are the flask-shaped bodies containing the long needle-like spores. This fungus is widely distributed in the south of England, and does much mischief in some districts, where it attacks many pasture grasses.

Protomyces macrosporus infests various umbelliferous plants, giving rise to conditions well shown in Plate XXVII., in which we see a large indurated swelling on the stalk of the Hemlock Water Dropwort, and numerous swollen seed-vessels. The tumefactions are at first pale yellow, then pinkish, and finally brown. They contain the spores which are formed in the continuity of the mycelial hyphae. These galls may be found from May to October; they are very uncommon.

There are some excellent photographs in Connold's "Oak Galls" of the cankerous growths commonly seen on the branches of young Oaks in many counties. They are attributed to the fungus *Dichaena quercina*, but mycological authorities agree that this is not at all likely, and the cause of these tumours still awaits investigation. The first indication is rounded swellings about the size of peas, these coalesce and not infrequently girdle the stem. They grow slowly, and in a few years become deeply fissured. I have never observed a fungus upon these hypertrophies. Connold also figured, in "Plant Galls," roots of *Araucaria imbricata* with large tumours, which he attributed to the presence of *Peridermium elatinum;* also similar growths on Hazel, Sallow, etc. There is a considerable collection of wood tumours in the Haslemere Museum on stems and branches of Scots Pine, Cedar, Hazel, Elder, Holly, Larch, Horse Chestnut, Beech, Birch, etc., and on roots of Scots Pine and Vines, but in no instance is it possible to state with confidence the primary cause of the overgrowth. It may have resulted from mechanical injury to a bud, from insect or fungus irritation, or from the presence of a bacterium.

Galls caused by Mycetozoa

There are certain organisms which occupy neutral ground on the borderland of the Animal and Vegetable Kingdoms. They form the group known as Mycetozoa, or Fungus-animals. In one stage of the life-cycle they exhibit affinities with plants, in another they approach more nearly to the Protozoa. At least two species give rise to galls on the plants which they infest. The best known is *Plasmodiophora brassicae*, a species which gives much trouble to gardeners and farmers, causing the only too well known "finger and toe" disease of Turnips, Swedes, Cabbages, and other cruciferous plants. It usually attacks the root, giving rise thereon to nodular or warty outgrowths. Sometimes the entire root is swollen, clubbed, and distorted (see Leaflet 77, Board of Agriculture). Another mycetozoon gall structure may be seen in Plate XVI., Fig. 2, which delineates the stem of the Germander Speedwell with tumours caused by *Sorosphaera veronicae*. The life-history of this parasite resembles that of *Plasmodiophora brassicae*. The spores, however, are united in a hollow sphere; in *P. brassicae* they are free and regularly formed. Blomfield and Schwartz described in detail the life-history in *Annals of Botany*, January, 1910, and observed: "We have been successful in producing tumours by sowing *Veronica* seeds in a pot and sprinkling them with water containing the sporospheres from dried tumours pounded with a pestle in the water. There was no evidence of any disease in the roots, many of the young roots being examined microscopically with reference to this possibility; for this reason, doubtless, the parasite does little damage to the host plant; its effect is largely local, and we find no such destruction as that caused by *Plasmodiophora* in Cabbage plants." I am indebted to Dr. Blomfield for the galled plant figured in the plate.

Economic Notes

Many gall-causing fungi are dreaded pests. The "black scab" of Potatoes and Beet is caused by *Oedomyces leproides* Trb. Large nodulose fleshy tumours occur on the upper part of the root of the Beet and on the young tubers of the potato.

Chrysophyctis endobiotica Sch. causes gall-like growths on the tubers and lower leaves of the Potato (see *Journal of Board of Agriculture*, ix., 1902, p. 320, paper by Professor Potter).

Exoascus deformans attacks the leaves of Nectarine, Peach, and Almond. The leaves become greatly hypertrophied and distorted, and brightly tinted with red and purple. This disease is very common. *Puccinia fabae* causes thickened white spots on the seed-pods of Beans and Peas.

The parasitic Rose canker *Coniothyrium Fuchelii* attacks cultivated as well as wild Roses, causing cankered overgrowths on the stems. It apparently attacks *Rubi* also. Plate XXVI. depicts cankered stems of *Rubus plicatus* from Dungeness.

An excellent illustration of a Bullace branch bearing what are popularly known as "pocket plums" or "bladder plums" may be seen in Plate XXV. This swollen and deformed condition of the fruit is caused by *Exoascus pruni*, a fungus which also attacks the Sloe, Wild Cherry, and cultivated Plums. The fruit of the fungus appears as a delicate whitish bloom in July. The fungus does not spread backwards on a branch, and may be kept in check by hard pruning.

The researches of F. P. Brzezinski on "Canker," extending over a period of seven years, indicate that the fungus *Nectria ditissima*, previously thought to be the cause of this disease, is only a saprophyte growing on dead tissue destroyed by other agents (see *Comp. Rend.*, May 20, 1902). Probably, as remarked above, the canker is in most cases due to the presence of insects or of a bacterium.

In June, 1911, the Board of Agriculture and Fisheries issued a leaflet (No. 245) concerning the crown-galls on Plum, Rose, raspberry, and logan-berry recently sent to Kew, and similar galls in every stage of development on the roots of the Paris Daisy (*Chrysanthemum frutescens, L.*).

"The galls are usually formed just under ground on the collar or root, and so escape observation. They commence growth as minute wart-like bodies; growth is rapid, and the surface of the gall becomes coarsely warted and dark coloured, and varies in size from 2 to 3 inches in diameter to that of a football, or even larger. The galls usually decay at the end of one season's growth, and leave an open wound, which penetrates for some distance into the wood. The following season gall growth commences round the edge of the wound formed in the previous season. These galls perish in turn, and the process is repeated each season, resulting in a large, deep wound. When two or three such wounds are present on different sides of the collar, the tree usually breaks off at the wounded part.

"Two distinct organisms have been found to occur in the tissues of the galls, but a bacterium, *Bacillus tumefaciens*, has been proved, in America, to be the primary cause of the disease."

For remedial and preventive measures the pamphlet should be consulted. Full particulars concerning the fungus pests mentioned in this chapter may be found in Massee's "Textbook of Plant Diseases" and the various leaflets issued by the Board of Agriculture and Fisheries.

A CLASSIFIED AND DESCRIPTIVE

CATALOGUE

OF

BRITISH GALLS

CATALOGUE OF BRITISH PLANT-GALLS

THE first catalogue of British plant-galls was compiled by Albert Müller, and published in 1872 in the *Entomologist's Annual.* The gall-causers represented five Orders of Insects in the following proportion: Hymenoptera 36, Coleoptera 9, Lepidoptera 2, Diptera 36, Homoptera 8—total 91.

The second catalogue was published twenty-six years later, by Mr. S. L. Mosley, in the *Naturalist's Journal.* It gave brief descriptions of 197 galls. The causers were arranged under the following headings: Hymenoptera 67, Coleoptera 8, Lepidoptera 3, Diptera 80, Homoptera 9, Acari 13, Nematoda 7, Unknown 5.

No catalogue has appeared since 1898. Early in 1909, the late Edward Connold published in his "Plant Galls of Great Britain," descriptions of 425 galls. No systematic arrangement was attempted, and no effort was made to enumerate all British records. A few galls caused by fungi were included. In the present catalogue over 800 galls, caused by Insects, Eelworms, and Fungi, are described. The numerical proportion of the causers under their Orders is as follows: Hymenoptera 136, Coleoptera 91, Lepidoptera 37, Diptera 248, Homoptera 117, Acari 76, Nematoda 25, Fungi and Mycetozoa 145. About 25 are imperfectly known.

The great majority of British naturalists possess a more or less intimate knowledge of our native wild plants; hence the most commendable basis of classification for a catalogue

of British plant-galls appears to be a botanical one, and such is here adopted. The families are arranged as in Engler's *Die Natürlichen Pflazenfamilien.* For the nomenclature of species I have followed the tenth edition of the well-known *London Catalogue of British Plants.*

The separate tabulation of galls caused on various parts of a plant by the same causer has not been attempted, because it involves too much repetition of names. The galls under each plant are arranged according to their causers, and in the sequence set forth above.

To facilitate easy reference, the section to which the causer belongs is indicated in the left-hand margin of the page.

The name in italics which, in a few cases, immediately follows the description of the gall is that given to it by writers before its character was properly understood. The number that follows the reference to the imago indicates the year of its emergence—I, II, and so on.

The term "aphis" concerns the apterous viviparous female.

"M. G." denotes that metamorphosis takes place within the gall; "M. E." that the larva pupates in the earth. The illustrations in this volume are cited within brackets. The synonymic names (in italic type) precede the citation of authorities, and both follow the name of the causer, which is in heavy type, and is followed by a number in the right-hand margin of the page. The references to authorities should be read in connexion with the more detailed description in the alphabetical bibliography which follows. It may be remarked that in all cases, unless expressly stated otherwise, the references to the following authors concern their works here mentioned:

Houard, *Zoocécidies des Plantes d'Europe*, the number being that appended to the gall therein.

Plowright, *Monograph of British Uredineae and Ustilagineae.*

Buckton, *Monograph of British Aphides.*

Cameron, *British Phytophagous Hymenoptera.*

The majority of our plants have well-established popular names; these I have given, and included in the general index.

The number which follows the scientific names of the plants indicates the number of counties in which the species have been reported to occur, and is taken from the tenth edition of the *London Catalogue*.

It cannot be expected that a catalogue of this magnitude will be free from errors. The literature of the subject being so widely scattered (see Bibliography), it is highly probable that many records have been overlooked. I claim the indulgence of my readers on this score, and invite their kind assistance towards the preparation of a second edition by means of letters of criticism, and by sending galls of which mention has been omitted.

FILICES

Pteris aquilina Linn. 112. Bracken.

Hymenoptera Pinnules swollen and discoloured, containing several eggs. The larvae feed externally on the frond.

SELANDRIA TEMPORALIS Thoms. 1

Houard, No. 70.

Fusiform swelling at the base of the frond, surface irregularly dented or rugged. Cavity central, 20 to 40 mm. long, containing a single larva.

CYNIPS sp. 2

Connold, Plant Galls, fig. 70. Apparently the same is alluded to by Houard (No. 71), but is described as multilocular.

Diptera Margins of the pinnules rolled inwards and greatly thickened; reddish at first, becoming quite black at maturity. Each roll contains a pale orange-yellow larva. M. E. (Plate XVIII.)

PERRISIA FILICINA Kieffer 3

Syn. *Cecidomyia pteridis* Müller.

Connold, Veg. Galls, pl. 83; Plant Galls, fig. 71. A. Muller, 1871, pp. 99, 100. Trail, 1878, pp. 77, 78. Houard, No. 68.

" Tip of the frond more or less rolled inwards, each lobe containing a white larva. M. E.

ANTHOMYIA SIGNATA Brischke 4

Houard, No. 65.

Athyrium Filix-foemina Roth. 110. Lady Fern.

" Tip of frond rolled inwards. See No. 4.

ANTHOMYIA SIGNATA Brischke 5

Trail, 1878, p. 78. Houard, No. 63.

Lastrea Filix-mas Presl. 112. Male Fern.

Hymenoptera Pustules on the margins of the lobes.

SELANDRIA ANALIS Thoms. 6

Houard, No. 58.

Diptera Tip of frond rolled inwards. See No. 4.

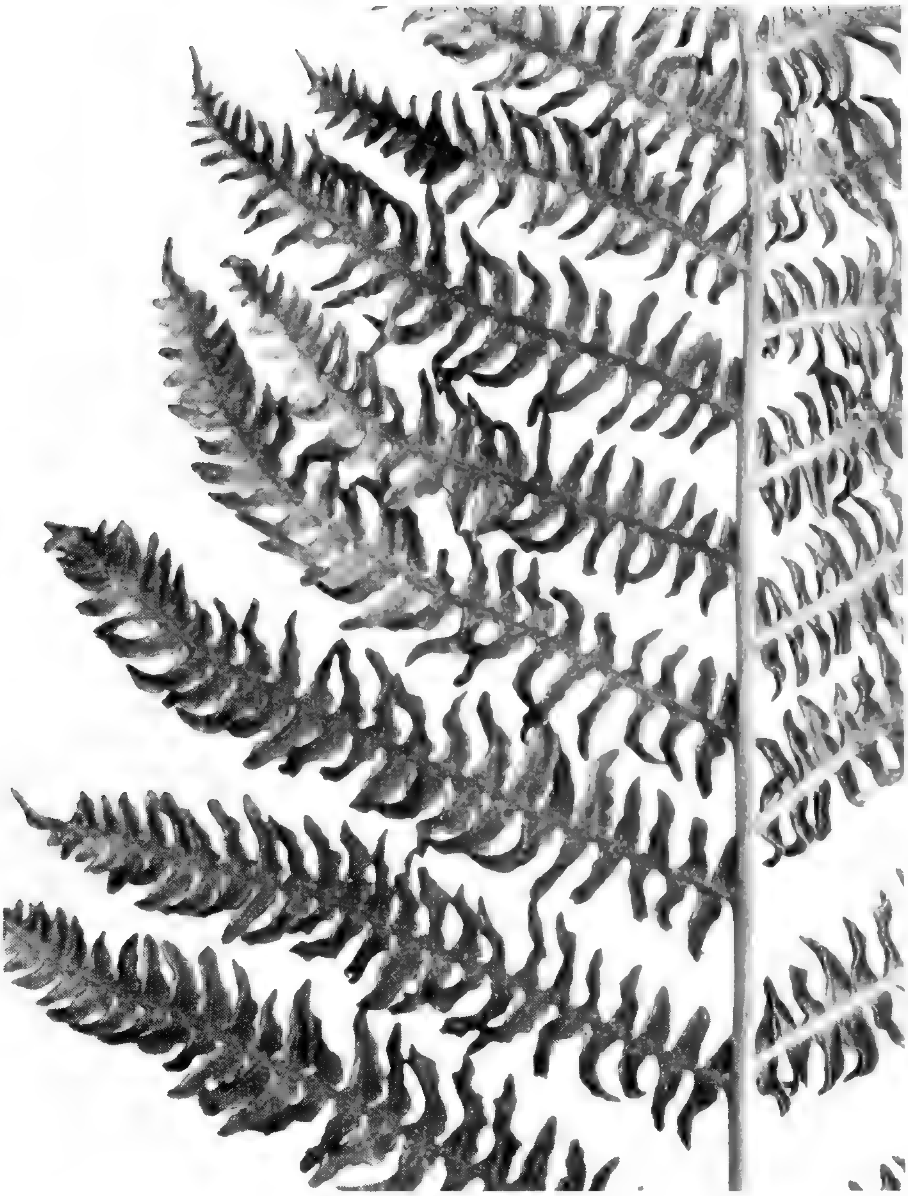
ANTHOMYIA SIGNATA Brischke 7

Houard, No. 56.

Lastrea aristata Rend. and Britt. (*dilatata* Presl.). 111. Buckler Fern.

" Tip of frond rolled inwards. See No. 4.

ANTHOMYIA SIGNATA Brischke 8



BRACKEN (*Pteris aquilina*) WITH THE MARGINS OF THE PINNULES ROLLED INWARDS AND THICKENED. THIS CONDITION ARISES THROUGH THE PRESENCE OF THE LARVAE OF THE GALL-GNAT *Perrisia filicina*

Ophioglossum vulgatum Linn. 88. Adder's-tongue.

Diptera Elongated swelling on the upper surface of the frond, about 15 mm. by 6 mm.; numerous larval cavities, each containing a greenish-white larva.

CECIDOMYIA sp. 9

Swanton, Naturalist's Journal, 1901, vol. x., p. 124. Connold, Plant Galls, fig. 110.

CONIFERAE

Juniperus communis Linn. 78. Common Juniper.

Lepidoptera Knotty swelling on the stem.

LOBESIA PERMIXTANA Hübner 10

Syn. *Lobesia reliquana*, Entom. Syn. List.
Houard, No. 133.

Diptera Fusiform terminal growth resembling a large bud. It comprises the three uppermost whorls of leaves and occasionally the fourth. The leaves of the first (innermost) are shortened, of a chestnut-brown tint, and form the larval cavity; those of the second are a little longer, carinated, and swollen at the base; those of the third (outermost) are of normal length, but enlarged and thickened at the base. Larva solitary, orange. M. G.

OLIGOTROPHUS JUNIPERINUS Linn. 11

Syn. *Hormomyia juniperina* Linn.
Connold, Plant Galls, p. 245. Houard, No. 129.

,, Little woody and hemispherical nodosity on the stem.

CECIDOMYIA sp. 12

Fitch, 1883, p. 6. Houard, No. 134.

Fungi Very apparent fusiform swellings on the branches and stems, bearing the ligulate, compressed, pale orange spore masses. April and May. Aecidiospores on *Crataegus monogyna* and *Pyrus communis*. (Plate XIX.)

GYMNOSPORANGIUM CLAVARIAEFORME Jacq. 13

Plowright, p. 233. Connold, Plant Galls, fig. 142.

Taxus baccata Linn. 17. Common Yew.

Diptera Artichoke-like growth at the termination of a twig, consisting of numerous shortened, soft leaves; externally a slightly lighter shade of green than normal, internally discoloured. Contains a single red larva. M. G.

OLIGOTROPHUS TAXI Inchbald 14

Syn. *Cecidomyia taxi* Inchbald.
Connold, Veg. Galls, pl. 88; Plant Galls, fig. 330. Houard, No. 150.

Homoptera Extremity of a shoot deformed, consisting of 8 to 16 rounded, brown, confluent, pea-like masses.

ADELGES TAXI Buckton 15

Buckton, Trans. Ent. Soc. Lond., 1886, p. 327. Houard, No. 152.

Diptera Bud swollen, sometimes 8 mm. in diameter, remaining nearly or completely closed, tinted with yellow or reddish brown. Attacked parts become fleshy and covered with minute granules or warts. (Plate XXI. 9.)

ERIOPHYES PSILASPIS Nalepa 16

Syn. *Phytoptus taxi* Murray.

Connold, Veg. Galls, pl. 60; Plant Galls, fig. 329. Houard, No. 153.

Pinus sylvestris Linn. 17. Scotch Pine.

Coleoptera Needles stunted, thickened in the middle, edges occluded, forming a cigar-shaped gall, the interior containing a velvety whitish larva with a black head. M. G.

BRACHONYX PINETI Payk. 17

Houard, No. 77.

Lepidoptera Resinous swelling in the bark of a branch, with a gallery containing a greenish-yellow larva with a brown head.

LASPEYRESIA COSMOPHORANA Tr. 18

Syn. *Coccyx cosmophorana* Entom. Syn. List. *Asthenia cosmophorana* Barrett.

Meyrick, Handbook Brit. Lep., p. 513.

,, Larva in a gallery beneath the bark of the branches, causing a lump of resinous exudation.

DIORYCTRIA SPLENDIDELLA H. S. 19

Syn. *Doryctria sylvestrella* Rag.

Meyrick, Handbook Brit. Lep., p. 369.

,, A globular mass of resin about the size of a small walnut at the apex of a twig, in which the larva pupates. Larva deep yellow with light brown head. Normal leaves grow through the gall, and stunted ones above it. (Plate VII. 8.)

RHYACIONIA RESINELLA Linn. 20

Syn. *Retinia resinella* Linn., *Evetria resinella* Linn.

Connold, Veg. Galls, pl. 37; Plant Galls, fig. 243. Houard, No. 75.

Diptera Leaves short, thickened, and discoloured; a reddish larva concealed in the sheath.

THECODIPLOSIS BRACHYNTERA Schwaegr. 21

Syn. *Diplosis pini* De Geer (?)

Connold, Plant Galls, p. 245.

Homoptera "On the terminal shoots of this tree (*Pinus sylvestris*), in the form of a small cone, much like the fruit of the tree in miniature, but with this difference, that the fruit

terminates in a point, whereas the pseudo-cone is nearly globular. Its colour also, instead of being green, is reddish ; but it exhibits the tiled scales of the fruit cone" (Rennie). "Gaine des aiguilles déformé et élargie en forme de coupe" (Houard).

ADELGES PINI Ratz. 22

Syn. *Aphis pini* Linn.

Rennie, Insect Architecture, p. 348 (1857). Houard, No. 78. Buckton does not allude to this gall in "British Aphides."

Acari Rounded nodular swelling about the size of a nut in the bark of a branch.

ERIOPHYES PINI Nalepa 23

Connold, Plant Galls, p. 245. Houard, No. 74.

Fungi Fusiform swellings in the young branches. Aecidiospores orange, contained in whitish sacs. May and June. The uredospores and teleutospores occur on various species of *Senecio*.

Aecidial stage of COLEOSPORIUM SENECIONIS Persoon 24

Syn. *Peridermium pini* Cher., *P. acicolum* Link.

Plowright, p. 248.

? Dense mass of twiggy outgrowths usually at the end of a branch, forming a "witch's broom." Often attaining large dimensions ; persisting for many years.

25

Swanton, Naturalist's Journal, February, 1903.

Picea excelsa Link (*Abies excelsa* D.C.). Common Spruce.

Homoptera Gall resembling a pineapple in miniature, about 25 mm. long, formed by the fusing together of the greatly swollen basal parts of the lower needles of a bud. The margins of the cavities between them are always hairy, and tinted red or brown. The shoot usually grows beyond the gall, which does not completely surround the branch. Aphis dingy green, seated at the base of the bud, eggs light yellow. The gall opens and the alatae (non-migratory) appear at the end of July.

CHERMES ABIETIS Kalt. 26

Syn. *Adelges abietis* Kalt.

Connold, Veg. Galls, pl. 34. Burdon, Journ. Econ. Biol., 1908, vol. ii., p. 125. Houard, No. 101.

,, Gall similar to that of *A. abietis*, but larger, 25 to 30 mm. long. Hairs around the openings purple or red, generally more brightly coloured than in *A. abietis*. Shoot usually grows beyond the gall. Aphis dark or light green, seated

at the base of the bud; eggs green. Gall opens about the middle of July; the alatae migrate to the Larch.

CHERMES VIRIDIS Ratz. 27

Syn. *Adelges viridis* Ratz.

Burdon, Journ. Econ. Biol., 1908, vol. ii., p. 124. Houard, No. 102.

Homoptera — Gall usually terminal, similar to that of *A. abietis*, but much smaller, about the size of a large pea; usually pale green with a whitish bloom, the mouths of the cavities seldom coloured. Growth never prolonged beyond the gall. Weak buds on poorly grown shoots are chiefly attacked. Aphis black, becoming greenish-brown in spring, seated *on* the bud; eggs yellow or greenish-yellow. The galls open about the middle of June; the alatae migrate to the Larch. (Plate X. 2.)

CHERMES STROBILOBIUS Kalt. 28

Syn. *Adelges strobilobius* Kalt., *Cnaphalodes strobilobius* Kalt.

Connold, Plant Galls, fig. 112, *a*. Burdon, Journ. Econ. Biol., 1908, vol. ii., p. 124. Houard, No. 94.

Picea orientalis. Oriental Spruce.

" — Gall terminal, elongated; usually one side only of the shoot is affected, and it becomes curved. The swollen bases of the needles do not usually fuse together to form definite cavities. Greenish-yellow with reddish hairs on the swollen parts. The shoot grows beyond the attacked part. Aphis dark brown, becoming yellowish-brown, seated on the stem a little distance *below* the bud; eggs brownish-yellow. According to Cholodkovsky, the intermediate hosts of this species are *Pinus sylvestris* and *P. strobus*.

CHERMES SIBIRICUS Cholod. 29

Syn. *Adelges sibiricus* Cholod.

Abies pectinata D. C. Common Silver Fir.

Fungi — Fusiform cankered swelling on the branches, with a mass of erect twigs bearing stunted yellowish leaves growing upon it. The aecidia are produced only on the leaves of the "witch's broom," not on the swollen branch. The teleutospore form occurs on species of *Cerastium*. (Plate XVII.)

Aecidial stage of MELAMPSORA CERASTII Persoon 30

Syn. *Uredo caryophyllacearum* Johnst., *Peridermium elatinum* Wallr.

Plowright, p. 248. Connold, Plant Galls, fig. 113.

Larix europaea D. C. Common Larch.

Homoptera — Needles bent, often at right angles, discoloured and swollen, with a dark brown woolly aphis seated in the

JUNIPER (*Juniperus communis*). A BRANCH GALLED BY THE FUNGUS *Gymnosporangium clavariaeforme*, THE ELONGATED FRUIT BODIES OF WHICH ARE SEEN PROTRUDING FROM THE SWOLLEN PART

angle. The alternate stage of the "pineapple" gall on the Spruce. (Plate X. 7.)

CHERMES STROBILOBIUS Kalt. 31

Syn. *Adelges strobilobius* Kalt.

Burdon, Journ. Econ. Biol., 1908, ii., p. 126.

? Densely fasciated mass of twigs at the end of a branch, sometimes at the apex of the stem, forming a "witch's broom," often of large dimensions. 32

Swanton, Haslemere Mus. Gaz., i., p. 535.

GRAMINEAE

Anthoxanthum odoratum Linn. 112. Sweet Vernal Grass.

Nematoda Stem abnormally thickened, short, bulbous near the base. Leaf sheaths enlarged, with swollen and wavy margin. Awn rudimentary or non-apparent.

TYLENCHUS DEVASTATRIX Kühn 33

Connold, Plant Galls, p. 191. Houard, No. 169.

Phleum pratense Linn. 111. Cat's-tail Grass.

Fungi Fusiform swelling immediately below the upper leaf sheath, white at first, becoming yellow at maturity. The presence of the fungus also causes abortion of the inflorescence, and checks growth above the part attacked.

EPICHLOE TYPHINA Persoon 34

Massee, Textbook of Plant Diseases, p. 125.

Agrostis canina Linn. 101. Brown Bent Grass.

Hymenoptera Ovoid swelling on the stem, with a cavity opening below.

ISOSOMA sp. 35

Trail, 1878. Houard, No. 194.

Fungi Fusiform swelling on upper part of stem. See No. 34.

EPICHLOE TYPHINA Persoon 36

Massee, Textbook of Plant Diseases, p. 125.

Agrostis alba Linn. 112. Marsh Bent Grass.

Homoptera Leaves elongated, clustered, internodes slightly swollen. Aphis yellow or shining black.

BRACHYCOLUS STELLARIAE Hardy 37

Trail, Aberdeen Nat. Hist. Soc. Trans., 1885. Houard, No. 186.

Nematoda Elongated swelling, about 5 by 3 mm., at the base of a leaf. Globular swelling about 2 mm. in diameter on the panicle. Greenish yellow, becoming reddish or purple.

TYLENCHUS TRITICI Bastian 38

Connold, Plant Galls, fig. 54. 39

Agrostis tenuis Sibth. (*vulgaris* With). 112. Fine Bent Grass.

Fungi Fusiform swelling on the stem. See No. 34.

EPICHLOE TYPHINA Persoon 40

Massee, Textbook of Plant Diseases, p. 125.

Ammophila arenaria Link. 64. Mat Grass.

Hymenoptera Haulm thickened at the summit, where the internodes are shortened. The imbricated leaves are often not larger than the enlarged sheath, the whole forming a pyriform mass. Larva pupates in the gall, imago appears the following April or May.

ISOSOMA HYALIPENNE Walker 41

Syn. *Eurytoma hyalipennis* Walker.

Connold, Veg. Galls, pl. 41; Plant Galls, fig. 155. Houard, No. 211.

Acari Haulm swollen at the sheath; the epidermic cells hypertrophied and assuming various shapes, usually either looped or twisted like a gimlet; hyaline at first, becoming brownish. M. G.

? TARSONEMUS SPIRIFEX Marchal 42

Connold, Plant Galls, fig. 156. Swanton, Knowledge, June, 1910.

Deschampsia caespitosa Beauv. 112. Tufted Hair Grass.

Fungi Fusiform swelling on the stem. See No. 34.

EPICHLOE TYPHINA Persoon 43

Holcus mollis Linn. 110. Creeping Soft Grass.

Homoptera Leaves erect, tufted. They "embrace each other at their bases like those of a sedge. In this manner a kind of boat is formed for the protection of the colony." Aphis yellow or shining black, mealy.

BRACHYCOLUS STELLARIAE Hardy 44

Hardy, North Brit. Agriculturalist, pt. ii, p. 788. Buckton, ii., p. 148. Houard, No. 218.

Fungi Fusiform swelling on the stem. See No. 34, and Plate XVI. 3.

EPICHLOE TYPHINA Persoon 45

Massee, Textbook of Plant Diseases, p. 125.

Holcus lanatus Linn. 112. Meadow Soft Grass.

Diptera Swelling on the stem in the immediate vicinity of a node, under the sheath of the corresponding leaf, tinted violet or purple. Larvae white, gregarious.

MAYETIOLA HOLCI Kieffer 46

Whitehead and Gray's Report, 1887. Houard, No. 215.

Fungi Fusiform swelling on the stem. See No. 34.

EPICHLOE TYPHINA Persoon 47

Massee, Textbook of Plant Diseases, p. 125.

Avena pubescens Huds. 94. Downy Oat Grass.

Fungi — Fusiform swelling on the stem. See No. 34.

EPICHLOE TYPHINA Persoon 48

Phragmites communis Trin. 104. Common Reed

Diptera — Lateral branches shortened, walls of the terminal internodes thickened and hardened. Interior of the haulm filled with a blackish grumous mass in which are reddish-yellow larvae, each living in an isolated and distinct gallery.

LASIOPTERA ARUNDINIS Schiner 49

Connold, Plant Galls, p. 246. Houard, No. 241.

,, — Isolated or grouped growths in the interior of the haulm, quite invisible externally. Each is firmly attached to the inner wall, and about 7 mm. long. Surface rough, pale yellow or brown, soft at first, becoming very hard at maturity. Each gall contains a white larva. M. G.

PERRISIA INCLUSA Frauenfeld 50

Syn. *Cecidomyia inclusa* Frauenfeld.

Connold, Plant Galls, p. 246. Houard, No. 245.

,, — Terminal fusiform swelling attaining the size of the middle finger. The axis of the stalk is shortened because of the arrested development of from ten to fifteen terminal internodes. The central cavity, 2 to 3 mm. in diameter, 50 to 80 mm. long, has very thick and woody walls. It contains a single larva. M. G.

LIPARA LUCENS Meigen 51

Connold, Veg. Galls, pl. 32; Plant Galls, fig. 258. Houard, No. 238.

Homoptera — Small depressions on the upper surface of the leaf, which is often powdered with yellow dust when the Aphides are numerous. Aphis bright green, more or less covered with yellow meal; cornicles dark grey, very small.

HYALOPTERUS ARUNDINIS Fabr. 52

Buckton, ii., 112. Houard, No. 247.

Cynosurus cristatus Linn. 112. Dog's-tail Grass.

Fungi — Fusiform swelling at the apex of the stem. See No. 34.

EPICHLOE TYPHINA Persoon 53

Poa annua Linn. 112. Annual Meadow Grass.

Nematoda — Plant bulbous at the base of the stem.

TYLENCHUS DEVASTATRIX Kühn 54

Connold, Plant Galls, p. 191. Houard, No. 260.

Fungi — Fusiform swelling near the apex of the stem. See No. 34.

EPICHLOE TYPHINA Persoon 55

Massee, Textbook of Plant Diseases, p. 125.

Poa nemoralis Linn. 93. Wood Meadow Grass.

Diptera — Medium or upper part of the stem swollen above a node. From the swelling issue numerous root-like filaments which curve around the stem. Each gall has a single cavity containing numerous larvae. M. G.

MAYETIOLA POAE Bosc. 56

Syn. *Hormomyia poae* Bosc.
Connold, Plant Galls, fig. 245. Houard, No. 264.

Nematoda — Plant bulbous at the base of the stem.

TYLENCHUS DEVASTATRIX Kühn 57

Fungi — Fusiform swelling near the apex of the stem. See No. 34.

EPICHLOE TYPHINA Persoon 58

" **Poa pratensis** Linn. 112. Smooth Meadow Grass.
Fusiform swelling on the stem. See No. 34.

EPICHLOE TYPHINA Persoon 59

Festuca ovina Linn. 112. Sheep's Fescue Grass.

Hymenoptera — Irregular yellowish-green swelling on the stem, situated above the first or second node. M. G. Imago appearing in spring.

ISOSOMA DEPRESSUM Walker 60

Syn. *Euura depressa* Cameron.
Connold, Plant Galls, p. 244. Walker, 1871, p. 451. Houard, No. 282.

Nematoda — Minute oval or elongated pustules, 1 to 2 mm. long, on the under surface of the leaf. Green or bluish-black.

TYLENCHUS GRAMINIS Hardy 61

Hardy, 1850, p. 182. Houard, No. 283.

Brachypodium sylvaticum Roem. and Schult. (*gracile* Beauv.). 111. Slender False Brome Grass.

Diptera — Top-shaped swelling on the stem in the vicinity of a node, causing a slight swelling outside the sheath. Chestnut-brown, becoming blackish.

CECIDOMYIA sp. 62

C. Zimmerman, 1907. Houard, No. 297.

Agropyron repens Beauv. 112. Couch Grass.

Hymenoptera — Spindle-shaped swelling on the stem.

AULACIDEA HIERACII Bouché 63

Syn. *Aulax hieracii* Sch.
Connold, Plant Galls, p. 114.

Diptera — Terminal internodes remaining short and thickened, within a cigar-shaped sheath formed by imbricated leaves. The cavity is elongated, and contains a yellowish-white larva. M. G.

CHLOROPS TAENIOPUS Meigen 64

Connold, Plant Galls, fig. 95.

Diptera Terminal bud hypertrophied; leaves elongated, forming a cigar-shaped, hard gall.

LONCHAEA PARVICORNIS Meigen 65

Connold, Plant Galls, p. 98. Houard, No. 314.

Nematoda Nodosities on the stem.

HETERODERA RADICICOLA Greeff 66

Connold, Plant Galls, p. 75, attributed to H. Schachtii, Kühn. Houard, No. 315.

CYPERACEAE

Eleocharis palustris Roem. and Schult. 111. Creeping Spike Rush.

Fungi Elongated rather flat swellings on the stalks Resting spores smooth, brown. August.

PHYSODERMA HELEOCHARIDIS Schroet. 67

Brit. Mycol. Soc. Trans., iii., p. 111.

Scirpus nanus Spreng. (*parvulus* Roem. and Schult.). 3. Small Club Rush.

,, Swellings on the roots containing the blackish-brown spore-masses.

USTILAGO MARINA Durieu 68

Plowright, p. 275.

Carex vulpina Linn. 86. Great Sedge.

Diptera Utricle swollen and elongated, thinner above, 8 mm. long. Containing an orange larva. Cocoon white. M. G.

PERRISIA MURICATAE Meade 69

Syn. *Dasyneura muricatae* Meade.

Connold, Plant Galls, fig. 82 (without name). Houard, No. 361.

Carex contigua Hoppe (*muricata* auct. angl.) 80. Great Prickly Sedge.

,, Utricle swollen. See No. 69.

PERRISIA MURICATAE Meade 70

Syn. *Cecidomyia muricatae* Meade.

Connold, Plant Galls, p. 244. Houard, No. 362.

Carex caespitosa Linn. 1. Tufted Sedge.

,, Globular swelling on the stem near its base, about the size of a wheat grain, brown or reddish-brown. Solitary or in groups of three to five. M. G.

PSEUDOHORMOMYIA GRANIFEX Kieff. 71

Connold, Plant Galls, fig. 83.

Carex limosa Linn. 26. Mud Sedge.

,, Elongated plurilocular excrescences, 5 to 8 mm. long,

between the sheaths of the lower leaves. White, thin and woody. M. G.

HORMOMYIA FISCHERI Frauenf. 72

Connold, Plant Galls, p. 244.

JUNCACEAE

Juncus bufonius Linn. 112. Toad Rush.

Fungi — In the cells of the periblem of the living root, causing swellings about 10 mm. long and 3 mm. in thickness.

Syn. *Entorrhiza cypericola* Mag.

SCHINZIA CYPERICOLA Magnus 73

Plowright, p. 299; Bernard, L'Évolution dans la Symbiose (1909).

Juncus squarrosus Linn. 108. Heath Rush.

,, — Root swollen. See No. 73.

SCHINZIA CYPERICOLA Magnus 74

Plowright, p. 299.

Juncus inflexus Linn. (*glaucus* Ehrh.) 90. Hard Rush.

Homoptera — Terminal leaves forming a compact, imbricated, tassel-like mass. The leaves are atrophied, swollen, tinted red and purple below. Numerous larvae in the enlarged sheaths.

LIVIA JUNCORUM Latr. 75

Syn. *Livia lamprocarpus* Latr.

Houard, p. 99, and No. 402.

Juncus effusus Linn. 112.

,, — Terminal leaves swollen and deformed. See No. 75.

LIVIA JUNCORUM Latr. 76

Houard, No. 400.

Juncus conglomeratus Linn. 112.

,, — Terminal leaves swollen and imbricated. See No. 75.

LIVIA JUNCORUM Latr. 77

Scott, 1876, pp. 565, 566. Houard, No. 399.

Juncus bulbosus Linn. 107. Lesser Jointed Rush. (*Juncus supinus* Moench; *J. uliginosus* Meyer.)

,, — Terminal leaves swollen and imbricated. See No. 75.

LIVIA JUNCORUM Latr. 78

Houard, No. 406.

Fungi — Root swollen. See No. 73.

SCHINZIA CYPERICOLA Magnus 79

Plowright, p. 299.

Juncus articulatus Linn. 110. Shining-fruited Jointed Rush (*Juncus lamprocarpus* Ehrh.).

Homoptera — Terminal leaves forming a tassel. See No. 75.

LIVIA JUNCORUM Latr. 80

Connold, Veg. Galls, pl. 103; Plant Galls, fig. 267 (printed upside down). Houard, No. 397.

Fungi — Root swollen. See No. 73.

SCHINZIA CYPERICOLA Magnus 81

Plowright, p. 299.

Juncus sylvaticus Reich 111. Sharp-flowered Jointed Rush (*Juncus acutiflorus* Ehrh.).

Homoptera — Terminal leaves imbricated. See No. 75.

LIVIA JUNCORUM Latr. 82

Houard, No. 405.

LILIACEAE

Colchicum autumnale Linn. 40. Meadow Saffron.

Fungi — Swollen patches and lines on the leaves containing the black spore-mass. April to July.

UROCYSTIS COLCHICI Schlecht 83

Syn. *Urocystis colchici* Tulasne.

Plowright, p. 286.

JUGLANDACEAE

Juglans regia Linn. Walnut.

Acari — Swollen rounded patches, 10 to 15 mm. in diameter, and about 5 mm. high, chiefly on the upper surface of the leaf; the concavity below is lined with a felt of white filiform hairs. *Erineum juglandineum* Persoon.

ERIOPHYES TRISTRIATUS Nalepa, var. ERINEA 84

Nalepa Connold, Veg. Galls, pls. 70, 75, *a*. Houard, No. 462.

MYRICACEAE

Myrica Gale Linn. 85. Bog Myrtle or Sweet Gale.

Fungi — Masses of tubercles on the adventitious roots, varying in size from a pea to a small walnut. Each tubercle is di- or trichotomously divided, and each tip ends with a long, slender, thread-like appendage. Flesh colour. I. to XII.

FRANKIELLA BRUNCHORSTII (Möller) René Maire 85

Syn. *Frankia subtilis* Brunchorst., *Frankia Brunchorstii* Möller.

I have received specimens from Newton Abbot. These galls are probably common.

SALICACEAE

Salix pentandra Linn. 59. Bay-leaved Willow.

Hymenoptera — An irregularly ovoid swelling on the stem, about the size of a hazelnut, formed of hard, woody tissue, and contain-

ing a whitish larva. Larger plurilocular galls attaining the size of a walnut often result from fusion of adjacent ones. Larval cavities in the pith. M. G. Imago appearing in June.

CRYPTOCAMPUS MEDULLARIUS Hartig 86

Syn. *Euura pentandrae* Cameron.

Cameron, ii., p. 211, pl. 11, fig. 1. Connold, Plant Galls, fig. 313. Houard, No. 568.

Hymenoptera Leaf margin rolled towards the lower surface usually for its entire length; occasionally both margins are simultaneously loosely rolled.

PONTANIA LEUCOSTICTA Hartig 87

Syn. *Nematus leucostictus* Hartig, *Nematus crassulus* Thoms.

Cameron, ii., p. 189. Houard, No. 570.

Salix triandra Linn. 66. Almond-leaved Willow.

Diptera Male catkins deformed. The filaments of the stamens and the scales are thickened and covered with a white woolly pilosity. Occasionally the terminal leaves are bunched into a rosette through the arrested development of the internodes between them, and are covered with a similar pubescence. Larvae gregarious, orange coloured. M. G.

RHABDOPHAGA HETEROBIA H. Löw 88

Syn. *Cecidomyia heterobia* H. Löw. 89

Connold, Plant Galls, fig. 229. Houard, No. 654, 656.

Salix fragilis Linn. aggr. 90. Crack Willow or Withy.

Hymenoptera Elongated or reniform swelling, resembling a small bean, showing almost equally on both surfaces of the leaf, 10 mm. by 5 mm. maximum size, appearing in June. Surface corrugated, green at first, then more or less tinted with red. Solitary or gregarious, unilocular, never seated on the midrib. Each gall contains a single larva, green on the back, lighter underneath, with a brown head. Pupa white. M. G. or M. E. (Plate II. 1.)

PONTANIA PROXIMA Lepel 90

Syn. *Nematus gallicola* Ste., *Nem. Valisnierii* Htg.

Cameron, ii., p. 203, i., pl. 3, fig. 8. Connold, Veg. Galls, pl. 111; Plant Galls, fig. 315. Houard, No. 595.

Coleoptera Fusiform or rounded swellings on the smaller branches, with a cavity in the pith containing a large yellowish-white larva. M. G.

SAPERDA POPULNEA Linn. 91

Houard, No. 588.

Diptera Terminal leaves brought together by the arrested development of the internodes, remaining erect and rolled

one within the other, thickened and more or less deformed, brown. The fusiform cavity contains numerous reddish larvae (20 to 30). The gall dries up after the departure of the larva or imago. M. G. or M. E. (Plate VIII. 4.)

PERRISIA TERMINALIS H. Löw 92

Syn. *Dasyneura terminalis* H. Löw, *Cecidomyia terminalis* H. Löw.

Connold, Plant Galls, p. 246. Houard, No. 582.

Diptera Leaf margin tightly rolled towards the lower surface, tinted yellow or reddish, roll 3 mm. long. Numerous galls are usually present, and the margin is often rolled continuously for the greater part of its length on both edges of the leaf. M. G. I.

PERRISIA MARGINEMTORQUENS Winn. 93

Syn. *Dasyneura marginemtorquens* Bremi.

MacDougall, Gall-Gnats on Osiers and Willows, Jour. Bd. Agric., Oct., 1905. Houard, No. 590.

" Hypertrophy of woody tissue on branches up to 4 inches in diameter, causing an irregular and slight swelling. These galls usually occur in large numbers on one branch, causing an elongated fusiform swelling; the bark on its surface cracks and falls away. Larva greenish-yellow. M. G. Imago appearing the following May or June, leaving by a minute circular hole.

RHABDOPHAGA SALICIPERDA Dufour 94

Syn. *Cecidomyia saliciperda* Dufour.

R. Stewart MacDougall, Gall-Gnats on Osiers, Journ. Bd. Agric., Oct., 1905. Houard, No. 585.

" Fusiform or spherical plurilocular swelling up to 10 mm. in diameter on one-year twigs, caused by hypertrophy of the woody tissue. Surface pitted and of cork-like consistency. Petiole and midrib of the leaf also swollen; gall ovoid, hard, unilocular, yellowish-green, sometimes tinted with red. Larva whitish at first, then reddish. M. G., just below the outer skin. The pupa has a notch at the base of each antenna sheath. Imago appears late in May.

RHABDOPHAGA SALICIS Schrank 95

Syn. *Cecidomyia salicis* Schrank.

Connold, Plant Galls, fig. 314. Houard, No. 587.

Salix alba Linn. 92. White Willow.

Hymenoptera Bean-like swellings on the leaf blade. See No. 90.

Cameron observes that "on *Salix alba* the galls are usually pale green, rarely light red, and hairy below."

PONTANIA PROXIMA Lepel 96

Syn. *Nematus gallicola* Ste.

Cameron, ii., p. 203. Houard, No. 633.

Coleoptera Rounded swellings on the branches. See No. 91.
SAPERDA POPULNEA Linn. 97
Houard, No. 624.

Diptera Leaf margin tightly rolled towards the lower surface, forming a compact, short (3 mm. by 2 mm.) gall, which is smaller at each end, coloured yellow, red, or purplish-brown, and bent like a bow. Usually gregarious and sometimes coalescent, but the margin is never continuously rolled. Each gall contains a single larva.
PERRISIA INCHBALDIANA Mik. 98
Syn. *Cecidomyia clausiliae* Bre.
Connold, Plant Galls, fig. 323. Inchbald and Meade, 1886*b*, pp. 223-22[illegible]. Houard, No. 627.

,, Terminal leaves stunted and rolled. See No. 92.
PERRISIA TERMINALIS H. Löw 99
MacDougall, Journ. Bd. Agric., Oct., 1905. Houard, No. 614.

,, Slight swelling on the stem. See No. 94.
RHABDOPHAGA SALICIPERDA Dufour 100
R. Stewart MacDougall, Jour. Bd. Agric., Oct., 1905. Houard, No. 621.

,, Arrested development of the terminal internodes; the leaves are shortened and crowded, forming a rosette-like gall, which contains a pale red larva sheltered in a bundle of erect linear leaves. Sometimes all the leaves of the gall are atrophied and erect, and it then resembles a small fir-cone.
RHABDOPHAGA ROSARIA H. Löw 101
Syn. *Cecidomyia rosaria* H. Löw.
MacDougall, Gall-Gnats on Osiers and Willows, Journ. Bd. Agric., Oct., 1905. Houard, No. 613.

Acari Leaf margins tightly rolled, either upwards or downwards. The affected part is but slightly swollen, about 3 mm. long, glabrous, greenish or reddish. The galls are seldom coalescent, hence the deformity is not very apparent. Pubescent within.
ERIOPHYES sp. 102
Houard, No. 591.
According to Houard, the mites most frequently found in this gall are *Eriophyes truncatus* Nal., *E. tetanothrix* Nal., and *Phyllocoptes magnirostis* Nal. In all probability Connold's *Eriophyes marginatus* (see Veg. Galls, pl. 58, and Plant Galls, fig. 324) is one of these.

Salix alba Linn., var. **vitellina** Linn. 14.

Hymenoptera Margin of the leaf evenly rolled inwards until it meets

the midrib; the roll is usually on one margin only, and extends about two-thirds of the length.

PONTANIA VIMINALIS Hartig 103

Syn. *Nematus nigrolineatus* Cameron.

Cameron, ii., p. 194, pl. 11, fig. 7. Houard, No. 650.

Hymenoptera Buds greatly swollen, remaining closed and withering away. Each contains a single larva.

CRYPTOCAMPUS ATER Jurine 104

Syn. *Cryptocampus angustus* Hartig, *Euura nigritarsis* Cameron.

Inchbald, 1864, p. 47. Houard, No. 646.

Salix purpurea Linn. 76. Purple Osier.

,, Oval or long and narrow pustule on the upper surface of the leaf, parallel to but not touching the midrib, reddish or purple above, yellowish-green below. Sometimes there is a second pustule on the other half of the blade. Larva yellowish, with brown head and blackish eyes.

PONTANIA FEMORALIS Cameron 105

Syn. *Nematus femoralis* Cam., *N. ischnocerus* Zadd.

Cameron, ii., p. 196; i., pl. 5, figs. 5, 10. Houard, No. 706.

,, A spherical swelling (7 to 12 mm. in diameter) on the lower surface of the leaf, to which it is attached by a point; glabrous, green, yellow, or red. It appears on the upper side of the leaf merely as a rounded reddish spot. The gall is reduced to a thin shell before the larva quits it. M. E. (Plate II. 9.)

PONTANIA SALICIS Christ 106

Syn. *Nematus gallarum* Hartig, *N. viminalis* Vollenh., *N. Vollenhoveni* Cam., *N. salicis-cinereae* Cam.

Cameron, ii., p. 199. Houard, No. 708.

,, A large bean-shaped swelling equally developed on both surfaces of the leaf, between the midrib and the margin towards the base; yellowish-green or brownish-red, thin walled, with a spacious cavity containing a single large yellowish-green larva (15 mm. long) with reddish extremities, and black spots above its feet. M. E.

PONTANIA VESICATOR Bremi 107

Syn. *Nematus vesicator* Cameron.

Cameron, ii., p. 183; i., pl. 5, fig. 8.

,, Leaf margin rolled inwards. See No. 103.

PONTANIA VIMINALIS Hartig 108

Cameron, ii., p. 194. Houard, No. 701.

,, Leaf stalk swollen (diameter 3 mm.); the swelling often extends the entire length and involves the midrib.

Greenish-yellow tinted with red. Larval cavity usually axial.

CRYPTOCAMPUS VENUSTUS Zadd. 109

Syn. *Euura venusta* Zadd.
Houard, No. 697.

Diptera Fusiform or spherical swellings on one-year twigs. See No. 95.

RHABDOPHAGA SALICIS Sch. 110

MacDougall, Journ. Bd. Agric., Oct., 1905. Houard, No. 696.

,, Slight swelling on the stem. See No. 94.

RHABDOPHAGA SALICIPERDA Duf. 111

MacDougall, Journ. Bd. Agric., Oct., 1905. Houard, No. 695.

,, Terminal leaves shortened and rosette-like. See No. 101.

RHABDOPHAGA ROSARIA H. Löw 112

MacDougall, Journ. Bd. Agric., Oct., 1905. Houard, No. 684.

Salix purpurea Linn., var. **Woolgariana** Borr.

Hymenoptera Spherical swelling on the lower side of the leaf. See No. 106.

PONTANIA SALICIS Christ. 113

Connold, Plant Galls, fig. 319. Cameron, ii., p. 199.

,, Bean-shaped swelling on the leaf. See No. 107.

PONTANIA VESICATOR Bremi 114

Connold, Plant Galls, fig. 320.

Lepidoptera Fusiform swelling, 10 to 20 mm. long, 5 to 8 mm. in diameter, on the older branches, not on the one year shoots ; green, with a central elongated cavity containing a caterpillar. M. G. (Text, Figs. 8, 9.)

GRAPHOLITHA SERVILLEANA Dup. 115

Syn. *Hedya servilleana* Entom. Syn. List., *Acrolita servilleana* Barrett.
Houard, No. 694.

Salix purpurea Linn. × **viminalis** Linn. (*S. rubra* Hudson). 36. *S. Helix* Linn.

Hymenoptera Leaf margin rolled inwards. See No. 103.

PONTANIA VIMINALIS Hartig 116

Syn. *Nematus leucostigmus* Cam.
Cameron, ii., p. 194. Houard, No. 716.

Bean-shaped swelling on the leaf. See No. 107.

PONTANIA VESICATOR Bremi 117

Connold, Plant Galls, p. 237. Houard, No. 717.

Salix viminalis Linn. 88. Common Osier.

Hymenoptera Margin of the leaf turned towards the lower surface and slightly rolled.

PONTANIA SCOTASPIS Foerster 118

Houard, No. 753.

,, Fusiform swelling on the stem, 8 to 20 mm. long, with a large cavity in the woody tissue containing a caterpillar with brown head and black eyes. M. G. II.

CRYPTOCAMPUS ATER Jurine 119

Inchbald, 1864, p. 47. Houard, No. 741.

,, Leaf margin rolled loosely inwards. See No. 87.

PONTANIA LEUCOSTICTA Hartig 120

Cameron, ii., p. 189. Houard, No. 752.

Lepidoptera Fusiform swellings on the older branches. See No. 115.

GRAPHOLITHA SERVILLEANA Dup. 121

Houard, No. 744.

Diptera Stem more or less swollen. See No. 94.

RHABDOPHAGA SALICIPERDA Duf. 122

MacDougall, Journ. Bd. Agric., Oct., 1905. Houard, No. 745.

,, Leaf margin rolled inwards. See No. 93.

PERRISIA MARGINEMTORQUENS Winn. 123

Connold, Veg. Galls, pl. 81; Plant Galls, fig. 234. Houard, No. 749.

,, Fusiform swellings on one-year twigs. See No. 95.

RHABDOPHAGA SALICIS Sch. 124

MacDougall Journ. Bd. Agric., Oct., 1905. Houard, No. 747.

Salix caprea Linn. 106. Goat Willow.

Hymenoptera An ovoid or spherical swelling, about 5 mm. in diameter, on the under surface of the leaf; green, yellow, or whitish, sometimes tinted red, covered with white hairs. Its presence is shown on the upper surface by a rounded yellowish-brown spot bordered with red, or sometimes entirely red. Solitary or gregarious. Larva solitary. (Plate II. 4.)

PONTANIA PEDUNCULI Hartig 125

Syn. acc. to Houard, *Nematus curticornis* Cameron, *N. bellus* Zaddach, *N. baccarum* Cameron.

Cameron, ii., pp. 198, 201; i., pl. 5, fig. 9. Connold, Veg. Galls, pl. 110; Plant Galls, fig. 273. Houard, No. 815.

,, Bean-like swelling on the leaf. See No. 90. Cameron observes that on *S. capraea* these galls are "somewhat

oval, dark shining green, glabrous above, very hairy beneath."

PONTANIA PROXIMA Lepel 126

Syn. *Nematus gallicola* Steph.
Cameron, ii., 203. Houard, No. 814.

Hymenoptera Bean-like swelling on the leaf. Usually closer to the midrib than that of *P. proxima*, and with the long axis parallel to it.

PONTANIA BRIDGMANI Cam. 127

Connold, Plant Galls, fig. 274. Houard considers it to be the same as *P. proxima* Lepel, but it appears to be a distinct species. Houard, No. 814.

,, Petiole and base of leaf considerably thickened, green or reddish in the centre. Each gall contains a yellowish-green larva.

CRYPTOCAMPUS SALICETI Fall. 128

Syn. *Cryptocampus gemmarum* Zadd., *Nematus mucronatus* Hartig.
Houard, p. 137.

,, Ovoid swelling on the stem. See No. 86.

CRYPTOCAMPUS MEDULLARIUS Hartig 129

Connold, Plant Galls, p. 246. Houard, No. 795.

,, Petiole swollen. See No. 109.

CRYPTOCAMPUS VENUSTUS Zadd. 130

Syn. *Euura venusta* Zadd.
Connold, Plant Galls, p. 212. Houard, No. 804.

,, Bud greatly swollen, remaining closed and withering away; also elongated swellings in the young branches, 8 to 20 mm. long, with a spacious internal cavity excavated in the woody tissue by a caterpillar with brown head and black eyes. M. G.

CRYPTOCAMPUS ATER Jurine 131

Syn. *Cryptocampus angustus* Hartig, *Euura nigritarsis* Cam., *Euura angusta* Cam. 131A
Connold, Plant Galls, fig. 270, p. 246. Houard, No. 790.

Coleoptera Rounded swellings on the branches. See No. 91.

SAPERDA POPULNEA Linn. 132

Houard, No. 802.

Lepidoptera Fusiform swellings on the older branches. See No. 115.

GRAPHOLITHA SERVILLEANA Dup. 133

Houard, No. 797.

Diptera Bud-like gall on the shoot.

DASYNEURA SALICINA Sch. 134

Syn. *Cecidomyia salicina* Sch.
Connold, Plant Galls, p. 246.

Diptera Leaf margin rolled inwards near the petiole. Rare on this species of Willow. See No. 93.

PERRISIA MARGINEMTORQUENS Winn. 135

MacDougall, Journ. Bd. Agric., Oct., 1905. Connold, Plant Galls, fig. 350. Houard, No. 807.

,, Ovoid or spherical swelling, 1 to 5 mm. in diameter, on both surfaces of the leaf, yellowish-green or pale yellow, often tinted with violet or reddish-purple above. Gregarious or coalescent. Opening inferior, rounded, larval cavity containing a single larva, white at first, then orange, red at maturity. M. E.

OLIGOTROPHUS CAPREAE Winn. 136

Syn. *Hormomyia capreae* Wtz.

Connold, Veg. Galls, pl. 95; Plant Galls, fig. 272. Houard, No. 812.

,, Terminal leaves shortened, forming a rosette. See No. 101.

RHABDOPHAGA ROSARIA H. Löw 137

MacDougall, Journ. Bd. Agric., Oct., 1905. Houard, No. 784.

,, Fusiform swellings on one-year twigs. See No. 95.

RHABDOPHAGA SALICIS Sch. 138

MacDougall, Journ. Bd. Agric., Oct., 1905. Connold, Veg. Galls, Pls. 26, 27; Plant Galls, fig. 269. Houard, No. 800.

,, Stem more or less swollen. See No. 94 and Plate IX. 10.

RHABDOPHAGA SALICIPERDA Dufour 139

MacDougall, Gall-Gnats on Osiers and Willows, Journ. Bd. Agric., Oct., 1905. Houard, No. 798. The galls depicted on Plates XXVI. and XXVII. of Connold's "Vegetable Galls," and on Fig. 269 of "Plant Galls," are caused by the presence of *Rhabdophaga salicis* Sch., not *R. saliciperda*, as therein stated.

Acari Pedunculated yellowish or reddish pubescent pustule on the upper surface of the leaf. The interior may be either subdivided by projections or quite smooth. Aperture inferior, surrounded by hairs. Gregarious or coalescent.

ERIOPHYES TETANOTHRIX Nalepa 140

Connold, Veg. Galls, pl. 66; Plant Galls, fig. 271.

,, Smooth pustular growth on the leaf, showing equally on both surfaces, yellow or red. Interior smooth, or subdivided by excrescences from its walls. Gregarious or coalescent.

ERIOPHYES SALICIS Nalepa 141

Houard, p. 146. There is some doubt concerning the species of *Eriophyes* responsible for this gall and the preceding one.

Fungi Circular or irregular large black patches, 4 to 5 mm. thick, on the upper surface of the leaves, white inside. Autumn and winter.

RHYTISMA SALICINUM Fries. 141*a*

Syn. *Xyloma salicinum* Persoon.

Massee, Brit. Fung. Flora, iv., 71, 72.

Salix aurita Linn. 106. Round-eared Sallow.

Hymenoptera Leaf stalk swollen. See No. 109.

CRYPTOCAMPUS VENUSTUS Zadd. 142

Houard, No. 852.

,, Pea-like excrescence on under surface of the leaf. See No. 125.

PONTANIA PEDUNCULI Hartig 143

Connold, Plant Galls, p. 238. Cameron, ii., p. 198. Houard, No. 863.

,, Oval or elongated pustules on the upper surface of the leaf. See No. 105.

PONTANIA FEMORALIS Cameron 144

Syn. *Nematus femoralis* Cameron.

Connold, Plant Galls, fig. 322.

,, Bud greatly swollen, remaining closed, and ultimately shrivelling up. Contains a solitary larva. M. E. Imago II.

CRYPTOCAMPUS SALICETI Fall. 145

Connold, Plant Galls, p. 246. Houard, No. 836.

Coleoptera Rounded or fusiform swelling on the stem. See No. 115.

SAPERDA POPULNEA Linn. 146

Houard, No. 850.

Lepidoptera Fusiform swellings on the older branches. See No. 94.

GRAPHOLITHA SERVILLEANA Dup. 147

Houard, No. 845.

Diptera Terminal leaves forming a rosette. See No. 101.

RHABDOPHAGA ROSARIA H. Löw 148

Connold, Veg. Galls, pls. 85, 86; Plant Galls, fig. 321. Houard, No. 827.

,, Fusiform swellings on one-year twigs. See No. 95.

RHABDOPHAGA SALICIS Sch. 149

MacDougall, Journ. Bd. Agric., Oct., 1905. Houard, No. 848.

Salix cinerea Linn. 106. Grey Willow.

Hymenoptera Bean-like swelling on the leaf. See No. 90.

Cameron observes that the galls on this species of Willow are "oblong, dark green, like those on *S. capraea*, but are smaller and more hairy."

PONTANIA PROXIMA Lepel 150

Syn. *Nematus gallicola* Ste.

Cameron, ii., p. 203. Houard, No. 903.

Lepidoptera Fusiform swellings on the older branches. See No. 115.
GRAPHOLITHA SERVILLEANA Dup. 151
Houard, No. 887.

Diptera Elongated swelling on the young twigs (12 by 6 mm.), coalescent, and split into wavy longitudinal furrows. This gall resembles that of *Cryptocampus ater* (see No. 119). It differs in having a very small internal cavity, containing a greenish-white larva without a distinct head.
AGROMYZA SCHINERI Giraud 152
Connold, Veg. Galls, pls. 23, 24; Plant Galls, fig. 317. Houard, No. 882.

,, Terminal leaves forming a rosette. See No. 101.
RHABDOPHAGA ROSARIA H. Löw 153
MacDougall, Journ. Bd. Agric., Oct., 1905. Houard, No. 872.

,, Male catkins deformed. See No. 88.
RHABDOPHAGA HETEROBIA H. Löw 154
MacDougall, Journ. Bd. Agric., Oct., 1905.

,, Fusiform swellings on one-year twigs. See No. 95.
RHABDOPHAGA SALICIS Sch. 155
MacDougall, Journ. Bd. Agric., Oct., 1905. Connold, Veg. Galls, pl. 28. Houard, No. 890.

Salix cinerea Linn. × **phylicifolia** Linn. (*S. laurina* Sm.). 11.

Hymenoptera Oval or elongated swellings on the upper surface of the leaf, usually in pairs.
PONTANIA FEMORALIS Cameron 156
Syn. *Nematus ischnocerus* Thom.
Cameron, ii., p. 196. Houard, No. 946.

,, Bean-like swelling on the leaf. See No. 107.
PONTANIA VESICATOR Bremi 157
Connold, Plant Galls, p. 237. Houard, No. 945.

Salix repens Linn. 98. Creeping Willow.

Diptera Terminal leaves forming a rosette. See No. 101.
RHABDOPHAGA ROSARIA H. Löw 158
Houard, No. 910.

Lepidoptera Fusiform swellings on the older branches. See No. 115.
GRAPHOLITHA SERVILLEANA Dup. 159
Houard, No. 917.

Salix herbacea Linn. 31. Dwarf Willow.

Hymenoptera Roundish bean-like swelling on the leaf. See No. 150. As a rule, one gall on a leaf. Cameron says of the larva that it is the only gall-inhabiting larva of the Ten-

thredinidae which bears regularly arranged marks on the body. Scotland and Cumberland.

PONTANIA PROXIMA Lepel 160

Syn. *Nematus herbacea* Cameron.

Connold, Plant Galls, fig. 316. Cameron, ii., p. 203. Houard, No. 1013.

Populus alba Linn. 70. White Poplar.

Coleoptera Fusiform or rounded swellings on the twigs and small branches, with a cavity in the pith containing a large yellowish-white larva. M. G.

SAPERDA POPULNEA Linn. 161

Houard, No. 476.

Lepidoptera Branch swollen, the long larval cavity, 110 mm. by 4 to 5 mm., opening at the exterior in the centre of an irregular lateral nodosity. M. G.

SCIAPTERON TABANIFORME Rott., var. RHINGIAEFORME Hübner 162

Houard, No. 6218.

,, Young branches slightly swollen, with shortened and distorted ramification.

GYPSONOMA ACERIANA Dup. 163

Syn. *Hedya aceriana* Barrett.

Houard, No. 478.

Fungi Convex blisters or swollen patches on the upper surface of the leaf, with a corresponding concavity below, up to 1 cm. across, golden-yellow.

TAPHRINA AUREA Fries. 164

Syn. *Ascomyces aureus* Magnus., *Exoascus aureus* Sadebeck, *Exoascus populi* Thüm.

Massee, Textbook Plant Diseases, p. 91.

Populus alba Linn. × **tremula** (*P. canescens* Sm.). 49. Grey Poplar.

Coleoptera Fusiform or rounded swellings on the branches. See No. 161.

SAPERDA POPULNEA Linn. 165

Houard, No. 517.

Lepidoptera Young branches swollen near the apex, 20 mm. long by 12 mm. in diameter, yellowish or light brown.

GYPSONOMA ACERIANA Dup. 166

Syn. *Hedya aceriana* Barrett.

Connold, Veg. Galls, pl. 36; Plant Galls, fig. 250. Houard, No. 518.

Fungi Convex blisters on the upper surface of the leaf. See No. 164.

TAPHRINA AUREA Fries. 167

Massee, Textbook Plant Diseases, p. 91.

Populus tremula Linn. 105. Aspen.

Hymenoptera Petiole swollen. The eggs are laid on the leaf stalk, which becomes swollen and bends over on each side to cover the eggs. Larvae (July and August) green with black head, becoming orange, with twelve large black marks. Imago September 1.

TRICHIOCAMPUS VIMINALIS Fall. 168

Syn. *Cladius viminalis* Fall.

Theobald, First Rep. Econ. Zool., 1903, p. 37. This insect also occurs on various Willows, but I can find no records of its causing galls thereon.

Coleoptera Fusiform or rounded swellings on young branches. See No. 161 and Plate VI. 7.

SAPERDA POPULNEA Linn. 169

Connold, Veg. Galls, pl. 21; Plant Galls, fig. 37. Houard, No. 489.

Lepidoptera Petiole with an elongated swelling close to the base of the leaf, containing a pale yellow larva. (Plate VII. 4.)

NEPTICULA ARGYROPEZA Zell. 170

Syn. *N. apicella* Ste., of Meyrick's Handbook Brit. Lep., p. 726.

Houard, No. 495.

,, Shoots swollen, with a cavity containing a single larva.

LASPEYRESIA COROLLANA Hb. 171

Syn. *Laspeyresia Leegerana* Wilk.

Meyrick, Handbook Brit. Lep., p. 511. This insect was found once at Whittlesea Mere many years ago; perhaps now extinct in Britain.

Diptera Leaf margins rolled upwards, but not tightly; yellow-green, becoming brown. Slightly pilose. M. E.

CONTARINIA sp. 172

Connold, Plant Galls, fig. 40. Swanton, Knowledge, June, 1910, erroneously recorded as caused by *Eriophyes dispar* Nalepa. Houard, No. 502.

,, Small rounded swellings, about 5 mm. in diameter, on the twig or on the petiole, generally tinted with red, and slightly pubescent. The larval cavity has a conical prolongation, opening at maturity with a circular lateral orifice. Larva orange. M. E. 173

HARMANDIA PETIOLI Kieff. 174

Connold, Veg. Galls, pls. 94, 117; Plant Galls, fig. 39. Houard, Nos. 493, 497.

,, Rounded pustules (3 to 4 mm. in diameter) on the upper surface of the leaf, gregarious or coalescent, usually bright red or purple. The pustule is compressed at its base, and

opens by a slit on the inferior surface. Larva solitary, yellowish. M. E.

HARMANDIA TREMULAE Winn. 175

Connold, Plant Galls, fig. 41. Swanton, Knowledge, June, 1910. Houard, No. 506.

Acari Leaves very small, crinkled and thickened, yellow or red, often rolled upwards on one or both margins.

ERIOPHYES DISPAR Nalepa 176

Houard, No. 486.

,, Small, irregularly rounded, red pustules on the glands at the base of the leaf near the petiole.

ERIOPHYES DIVERSIPUNCTATUS Nal. 177

Connold, Plant Galls, p. 244. Houard, No. 499.

,, A swelling on the upper surface (usually) of the leaf, with a corresponding concavity below, the latter lined with numerous projections. Whitish at first, then brown.

PHYLLOCOPTES POPULI Nalepa 178

Erineum populinum Persoon.
Greville, 1827, pl. 250. Houard, No. 514.

Fungi Convex golden-yellow blisters on the leaf. See No. 164.

TAPHRINA AUREA Fries. 179

Connold, Plant Galls, p. 200.

,, Carpels becoming much swollen, and assuming a bright golden colour.

TAPHRINA JOHANSONII Sadebeck 180

Massee, Textbook Plant Diseases, p. 92.

Populus nigra Linn. Black Poplar.

Coleoptera Fusiform or rounded swellings on the young branches. See No. 161.

SAPERDA POPULNEA Linn. 181

Houard, No. 526.

Lepidoptera Young branches swollen above. See No. 163.

GYPSONOMA ACERIANA Dup. 182

Houard, No. 530.

,, Knotty swellings on branches of the first and second years' growth.

SCIAPTERON TABANIFORME Rött. 183

Houard, No. 527.

Homoptera Leaf margins bent downwards, with blisters on the under side and black patches on the upper. Aphis pale brownish-green, very hairy; eyes bright red. Larvae various shades of green.

CHAITOPHORUS LEUCOMELAS Koch 184

Buckton, ii., 136. Houard, No. 541*a*.

Homoptera Leaf margins bent inwards until they meet, forming a pouch. Aphis pale green, very woolly. Attacked leaves become brightly tinted with red, and are usually covered with little pustules. Sometimes only one margin is attacked. (Plate XII. 5.)

PEMPHIGUS AFFINIS Kalt. 185

Buckton, iii., 122. Houard, No. 541.

,, Petiole greatly swollen ; the swelling (15 to 30 mm. long) consists of contiguous spiral rolls, which are greenish-yellow at first, then reddish. The large internal cavity contains the Aphides in various stages of development. Aphis pale green, very woolly. Autumnal. (Plate XII. 9.)

PEMPHIGUS SPIROTHECAE Pass. 186

Buckton, iii., 122. Connold, Plant Galls, fig. 248 ; Veg. Galls, pl. 105. Houard, No. 535.

,, Bud deformed, making a vesicular gall about the size of a hazel nut with a rounded opening at its apex. It sometimes occurs on the petiole, and commonly on the leaf. Greenish-yellow, becoming tinted with red. Aphis dusky green 187
with fuscous head. (Plate XII. 6.) 188

PEMPHIGUS BURSARIUS Linn. 189

Buckton, iii., 117. Connold, Veg. Galls, pl. 104 ; Plant Galls, fig. 247. Houard, Nos. 523, 529, 533.

Fungi Golden-yellow blisters on the leaf. See No. 164.

TAPHRINA AUREA Fries. 190

Connold, Plant Galls, fig. 249. Massee, Textbook of Plant Diseases, p. 17.

BETULACEAE

Betula alba Linn. Aggr. 112. Common Birch.

Lepidoptera Ovoid or rounded swelling of a branch at the nodes, containing a whitish caterpillar.

EPIBLEMA TETRAQUETRANA Haw. 191

Syn. *Phloeodes tetraquetrana* Barrett.

Connold, Plant Galls, fig. 58 (without name). Houard, No. 1074.

Diptera Roundish pustules, 3 to 4 mm. in diameter, about 2 mm. in thickness, showing equally on both surfaces of the leaf. Solitary or gregarious, seldom coalescent, yellowish-green with a narrow band of red or purple at the margin. Each pustule contains a larva, white at first, then sulphur-yellow. M. E.

CONTARINIA BETULINA Kieff. 192

Connold, Plant Galls, fig. 63 (without name). Swanton, Knowledge, June, 1910. Houard, No. 1076.

Diptera Fusiform elongated swelling, 10 mm. long, on the midrib or on a lateral vein, green or violet, containing three or four larvae, which are white at first, then bright red. Metamorphosis takes place outside the gall on the dried-up leaf.

MASSALONGIA RUBRA Kieff. 193

Connold, Plant Galls, fig. 62 (without name). Swanton, Knowledge, June, 1910. Houard, No. 1075.

,, Catkin deformed and dwarfed.

(?) OLIGOTROPHUS BETULAE Winn. 194

Syn. *Cecidomyia betulae* Wtz.

Connold, Veg. Galls, pl. 120; Plant Galls, fig. 64. Binnie, 1877, p. 182. Houard, No. 1068 (without name).

Acari On the under surface of the leaf, usually in the axils of the nervures, in a depression corresponding with a more or less circular swelling (2 mm. high) on the upper surface, a mass of cylindrical contorted hairs. Reddish-brown above, the pubescence reddish. *Phyllerium tortulosum* Greville.

ERIOPHYES LIONOTUS Nalepa 195

Connold, Veg. Galls, pl. 55; Plant Galls, fig. 60. Houard, No. 1081.

,, Bud swollen, up to 10 mm. in diameter, with more or less imbricated and recurved scales. The branch below the terminal gall is always thickened, and often quite arrested in development; if its growth is continued the internodes are usually shortened; ultimately a "witch's broom" results. Axillary buds are also attacked. Felt-like patches of white or reddish hairs on the leaf (usually below) are caused by the same agency. (Plate XX.) 196

ERIOPHYES RUDIS Canest. 197

Connold, Veg. Galls, pls. 16-20, 63; Plant Galls, fig. 59. Houard, Nos. 1072, 1085.

,, Irregular rounded swelling on the upper surface of the leaf, usually between the veins, covered with a rough yellow, brown, or red felt. The corresponding depression below filled with a mass of white club-shaped hairs. Solitary, gregarious, or coalescent. June to October.

ERIOPHYES RUDIS Can., var. LONGISETOSA Nal. 198

Connold, Plant Galls, fig. 61. Houard, No. 1083.

,, Numerous buds, slightly hairy, massed together on a more or less circular woody boss of variable size on the stem and larger branches.

ERIOPHYES sp. 199

Connold, Plant Galls, fig. 57. Houard, No. 1073.

BIRCH (*Betula alba*) WITH NUMEROUS "WITCHES-BROOMS" RESULTING FROM THE PRESENCE OF MITES, *Eriophyes rudis*. THIS TREE HAS BEEN UNDER OBSERVATION FOR MANY YEARS. THE "BROOMS" GROW VERY SLOWLY

Fungi — Dense masses of long twiggy outgrowths on the branches, often springing from a large woody core, forming a "witch's broom."

EXOASCUS TURGIDUS Sadebeck 200

Syn. *Ascomyces turgidus* Phil.
Massee, Brit. Fung. Flora, iv., pp. 17, 18.

Betula tomentosa Reith. and Abel (*pubescens* Ehrh.). 72. White Birch.

Acari — On the lower surface of the leaf, usually in the axils of the lateral veins, a depression lined with cylindrical contorted hairs. Slight swelling on upper surface. *Phyllerium tortuosum* Greville.

ERIOPHYES LIONOTUS Nalepa 201

Greville, 1824, ii., pl. 94. Houard, No. 1095.

Alnus rotundifolia Mill. (*glutinosa* Gaertn.). 110. Alder.

Lepidoptera — Slight swelling on a twig at the base of a petiole, sometimes causing flexure beyond the point of attack. The internal cavity contains a single larva.

EPIBLEMA TETRAQUETRANA Haworth 202

Syn. *Phloeodes tetraquetrana* Barrett.
Connold, Plant Galls, fig. 21. Houard, No. 1123.

" — Staminate catkins and young shoots deformed.

ARGYRESTHIA GOEDARTELLA Linn. 203

Syn. *Argyresthia literella* Haworth.
Connold, Plant Galls, fig. 26.

Acari — On the lower surface of the leaf (very rarely on the upper) a mass of unicellular hairs, white at first, becoming brownish. The hairs are much swollen and club-shaped at the extremity. There is a slight swelling or blister on the upper surface of the leaf. *Erineum alneum* Persoon.

ERIOPHYES BREVITARSUS Focken 204

It is doubtful whether Connold's illustrations (see Veg. Galls, pl. 49, and Plant Galls, fig. 23) are of this gall. Houard, No. 1133.

" — Little subspherical red excrescences on the upper surface of the leaf, about the size of a hemp-seed, constricted at the base. These pimples open on the inferior surface by a mouth situated on a slight swelling surrounded by a circular depression. The interior is lined with cylindrical hairs that are not visible externally. *Cephaloneon pustulatum* Bremi. (Plate XXI. 2.)

ERIOPHYES LAEVIS Nalepa 205

Connold, Veg. Galls, Pl. 54; Plant Galls, fig. 24. Houard, No. 1128.

Acari Hemispherical pustules (3 mm. high) on the upper surface of the leaf, always at the junction of the lateral veins and midrib. Yellowish-green, becoming red and brownish. Each pustule contains a cavity with a wide opening on the lower surface of the leaf. It is lined with hairs that are either white or a clear yellowish-brown. When the galls are very numerous the margins of the leaf are deflected. *Erineum axillare* Fée.

ERIOPHYES NALEPAI Focken 206

Connold, Veg. Galls, pl. 48; Plant Galls, fig. 22. Houard, No. 1132.

Fungi Pistillate catkins deformed, producing long tongue-like greenish or reddish outgrowths, which are either straight or curled, attaining 30 mm. in length. Solitary or gregarious, sometimes ten on one catkin. June to October. The same fungus also produces blisters on the upper surface of the leaves. (Text, Fig. 33.)

EXOASCUS ALNITORQUUS Winter 207

Syn. *Ascomyces alnitorquus* Massee. 208

Connold, Plant Galls, fig. 25. Swanton, Fungi and how to Know Them, pl. 14, fig. 6.

,, Branches swollen, bark destroyed, the margin of the wound surrounded by a thickened irregular mass of living bark, commonly known as "canker."

208*a*

Massee, Textbook of Plant Diseases, p. 127.

At one time supposed to have been caused by the fungus *Nectria ditissima*, which, however, is a saprophyte. Probably of bacterial origin.

Small white or yellowish blisters usually on the under surface of the leaves; less frequently on the upper surface.

TAPHRINA SADEBECKII Johans. 209

Massee, Textbook of Plant Diseases, p. 91.

,, Clusters of abnormal thickened tubercles, forming nodular spherical masses varying in size from a pea to a walnut. Sometimes occurring at the base of the stem. Reddish-brown or yellowish. I. to XII. (Plate XVI. 4.)

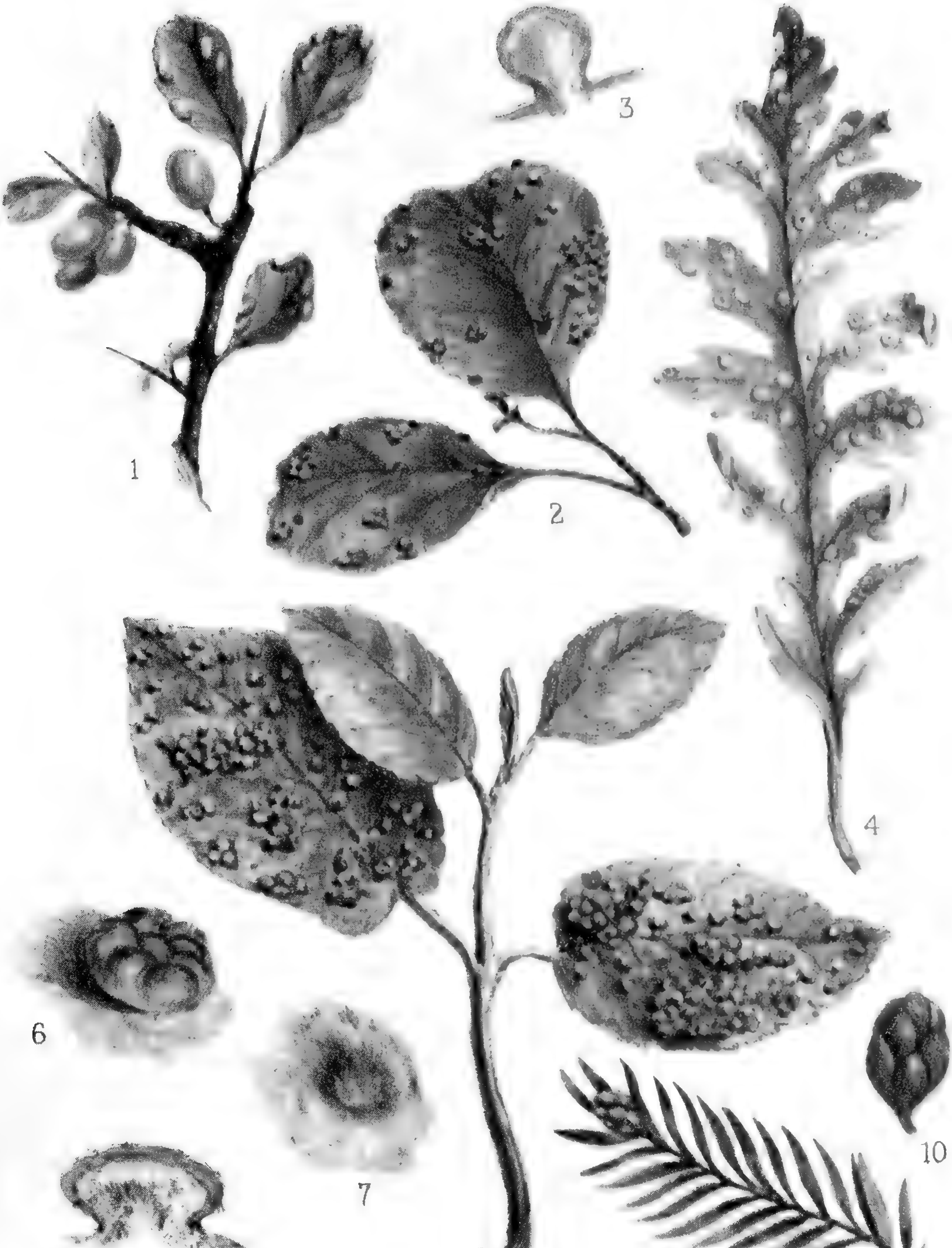
FRANKIELLA ALNI (Wor.) René Maire 210

Syn. *Schinzia alni* Woronin, *Plasmodiophora alni* Wor., *Frankia subtilis* Brunchorst.

Connold, Plant Galls, frontispiece and fig. 20.

Carpinus Betulus Linn. 37. Hornbeam.

Diptera The midrib is swollen on the upper surface of the leaf between two lateral veins, of which the bases are also swollen. The gall contains two cavities, each with a single



GALLS INDUCED BY MITES ON LEAVES OF BLACKTHORN, ALDER, GREAT KNAPWEED AND MEALY GUELDER ROSE, AND ON YEW BUDS

larva. The greater part of the midrib is often involved, the galls coalescent, and the leaf deformed.

PERRISIA CARPINI F. Löw 211

Syn. *Cecidomyia carpini* F. Löw.
Connold, Plant Galls, fig. 139. Houard, No. 1045.

Acari Slight swelling in the angle between the midrib and a lateral vein. The depression on the under surface of the leaf is covered with abnormal hairs.

ERIOPHYES TENELLUS Schl. 212

Connold, Plant Galls, fig. 141.

,, Leaf atrophied and wrinkled in a remarkable manner; the wrinkling extends from the margin to the midrib along the lateral veins, which are slightly swollen below.

ERIOPHYES MACROTRICHUS Nal. 213

Legnon confusum Bremi.
Connold, Plant Galls, fig. 140. Houard, No. 1046.

Fungi Dense mass of short twigs with atrophied leaves, usually seated upon a bough, forming the growth known as a "witch's broom."

EXOASCUS CARPINI Ros. 214

Connold, Plant Galls, fig. 137.

FAGACEAE

Corylus Avellana Linn. 111. Hazel.

Diptera Staminate catkins swollen, more or less pyriform, with enlarged, smooth scales. Larvae white, gregarious.

STICTODIPLOSIS CORYLINA F. Löw 215

Syn. *Diplosis corylina* F. Löw.
Connold, Plant Galls, p. 245.

Acari Masses of deformed twigs, forming a "witch's broom." The growth may be dense or straggling; the leaves are stunted, and the nodes are always swollen.

ERIOPHYES AVELLANAE Nal., var. ? 216

Connold, Veg. Galls, pls. 14, 15. A very doubtful diagnosis.

,, Staminate catkins swollen, more or less pyriform, scales enlarged and rough.

ERIOPHYES AVELLANAE Nal. 217

Connold, Plant Galls, fig. 134. Houard, No. 1053 (without name).

,, Bud deformed, hypertrophied, forming an almost spherical yellowish or reddish-brown mass about 8 to 10 mm. in diameter, composed of swollen scales, the innermost

covered with minute wart-like projections, amongst which the mites swarm in summer.

ERIOPHYES AVELLANAE Nal. 218

Syn. *Phytoptus coryli* Pers.

Connold, Veg. Galls, pl. 47; Plant Galls, fig. 133. Houard, No. 1056.

Quercus Robur Linn. 105. British Oak.

I. CYNIPIDAE WITH ALTERNATING GENERATIONS

Hymenoptera On the male catkin. Gall ovoid, about 2 mm. high, taking the place of a stamen, green at first, becoming brown. It is covered at the apex with a closely crowded mass of white hairs, 6 to 8 mm. long. It appears at the end of April. Sometimes all the stamens of a catkin are attacked; the axis of the latter does not develop, and the gall then appears as a mass of cottony threads surrounded by the bud scales. Imago, June, I.

ANDRICUS CIRRATUS Adler 219

Connold, Oak Galls, pl. 14; Plant Galls, fig. 220. Houard, No. 1185. Adler and Straton, Alternating Generations, pl. 2, fig. 11*a*.

,, In an axillary bud. Gall fusiform, with a long stalk; total length 20 mm., yellowish-green, becoming brown, marked with more or less pronounced longitudinal ribs. First appearing in May. Imago, spring, III.

ANDRICUS CIRRATUS, form CALLIDOMA 220

Syn. *Andricus callidoma* Giraud; *Aphilothrix callidoma* Hartig.

Connold, Oak Galls, pl. 18; Plant Galls, fig. 184. Houard, No. 1254. Adler and Straton, Alternating Generations, pl. 2, fig. 11.

,, On the leaf; the colour, shape, and size of a pea, glabrous above, slightly hairy below, provided with a large cavity containing an internal gall. Sometimes on the terminal twig. Always causing distortion and bending of the part attacked. Spring and summer. Imago, May and June, I. 221

ANDRICUS CURVATOR Hartig 222

Connold, Oak Galls, pls. 6, 7; Plant Galls, figs. 169, 195. Houard, No. 1351. Adler and Straton, Alternating Generations, pl. 1, fig. 9*a*.

, In an axillary bud. Gall minute, fusiform, 3 to 4 mm. long; its basal part, together with a small peduncle which supports it, is hidden by the bud scales. The apex is pointed; just below the point there is a circular depres-

sion, which keeps the green tint when the rest of the gall has become reddish-brown. Appearing in summer; mature in October, when it falls to the ground. Imago, spring, III.

ANDRICUS CURVATOR, form COLLARIS 223

Syn. *Andricus collaris* Hartig; *Aphilothrix collaris* Adler.

Connold, Oak Galls, fig. 8; Plant Galls, fig. 185. Houard, No. 1216. Adler and Straton, Alternating Generations, pl. 1, fig. 9.

Hymenoptera In the axillary and terminal buds. Gall very minute, ovoid, 2 mm. long, green, becoming brown, smooth and shining. Appearing in May. Imago, July or August, I.

ANDRICUS GEMMATUS Adler 224

Connold, Oak Galls, pl. 5; Plant Galls, fig. 177. Houard, No. 1297. Adler and Straton, Alternating Generations, pl. 1, fig. 7*a*.

,, In the bark at the base of the trunk, gregarious woody galls, each covered with a conical operculum, fleshy and red at first, which falls off at maturity, when the gall resembles a minute cone with its point buried in the bark, its base (3 to 4 mm. in diameter) slightly exposed. Around the edge of the base are a series of little punctiform depressions; in its centre a rounded smooth swelling, within which is the larval cavity. Imago, April or May, II.

ANDRICUS GEMMATUS, form CORTICIS 225

Syn. *Aphilothrix corticis* Linn. *Andricus corticis* Mayr.

Connold, Oak Galls, pls. 19, 20*a*; Plant Galls, fig. 166. Houard, No. 1291. Adler and Straton, Alternating Generations, pl. 1, fig. 7.

,, Terminal buds of a twig remaining short and thickened, causing a thick swelling (12 mm. by 7 mm.), bearing somewhat tufted leaves. The central cavity contains an internal gall firmly fixed to the bottom; lateral twigs often grow from the gall after the insect has emerged. Imago, June, I.

ANDRICUS INFLATOR Hartig 226

Connold, Oak Galls, pl. 11; Plant Galls, fig. 170. Houard, No. 1205. Adler and Straton, Alternating Generations, pl. 1, fig. 8*a*.

,, In a bud. Gall solitary, green, glabrous, 3 to 5 mm. in diameter, seated on a swelling and surrounded at its base by the bud scales, fleshy and soft beneath its outer layer. It contains an internal hard, woody gall, covered with a reticulated network of lines. The gall falls to the ground in October, and the internal one drops out. Imago in spring, II., III., VI.

ANDRICUS INFLATOR form GLOBULI 227

Syn. *Andricus globuli* Hartig; *Aphilothrix globuli* Adler.

Connold, Oak Galls, pl. 23; Plant Galls, fig. 187. Houard, No. 1277. Adler and Straton, Alternating Generations, pl. 1, fig. 8.

Hymenoptera Slight swelling, 1 to 5 mm. long, on the bark of a twig, due to the presence in the woody tissue beneath the bark of a small, ovoid, white gall, 1 to 3 mm. long. These galls are usually gregarious, and then cause pronounced irregular elongated swellings on the branch, which is sometimes completely distorted and atrophied. The swellings also occur on petiole and midrib. Imago, August or September, I., II.

ANDRICUS TRILINEATUS Hartig 228

Syn. *Andricus noduli* Hartig. 228*a*

Connold, Oak Galls, pl. 12; Plant Galls, fig. 171. Houard, No. 1294. Adler and Straton, Alternating Generations, pl. 1, fig. 5*a*.

,, Gall many-celled, situated on exposed roots or at the base of the trunk just above the earth; nodular, white or tinted with rose at first, rounded, attaining the size of a small apple, and somewhat fleshy. After the second spring it becomes very hard, woody, and dark brown. Imago, spring, III.

ANDRICUS TRILINEATUS form RADICIS 229

Syn. *Andricus radicis* Fabr.; *Aphilothrix radicis* Fabr.

Connold, Oak Galls, pl. 26; Plant Galls, figs. 163, 164. Houard, No. 1290. Adler and Straton, Alternating Generations, pl. 1, fig. 5.

,, On the male catkin, an ovoid, sharply pointed little gall, not exceeding 5 mm. in height, green at first, becoming brownish. Sometimes sparsely hairy at the apex. Gregarious. Rarely more than two clusters on a catkin. Imago, June, I.

ANDRICUS NUDUS Adler 230

Connold, Oak Galls, pl. 13; Plant Galls, fig. 222. Houard, No. 1191. Adler and Straton, Alternating Generations, pl. 2, fig. 12*a*.

,, In an axillary bud, solitary. Gall subsessile, fusiform, about the size of a grain of barley, green, with five or six longitudinal striae, often tinted bright red and converging to the blunt but slender pointed apex. It falls to the ground in September. Imago, spring, III.

ANDRICUS NUDUS, form MALPIGHII 231

Syn. *Andricus malpighii* Adler; *Aphilothrix malpighii* Adler.

Connold, Oak Galls, pl. 23; Plant Galls, fig. 188. Houard, No. 1283. Adler and Straton, Alternating Generations, pl. 2, fig. 12.

Hymenoptera On the male catkin. Gall minute, pyriform, about 2 mm. high, inserted in the axis of the catkin between two stamens; green at first, becoming brown, covered with erect white hairs. Usually solitary. Imago, June, I. (Text, Fig. 3.)

ANDRICUS PILOSUS Adler 232

Connold, Oak Galls, pl. 13; Plant Galls, fig. 223. Houard, No. 1189. Adler and Straton, Alternating Generations, pl. 1, fig. 10*a*.

" Bud greatly enlarged, resembling a hop-cone. The scales are imbricated and enlarged; there is a cavity between the central ones, at the bottom of which lies a small, hard, ovoid gall, containing the larva. Imago, spring, III., IV. (Text, Fig. 2.)

ANDRICUS PILOTUS, form FECUNDATOR 233

Syn. *Andricus fecundatrix* Cam.; *Aphilothrix fecundatrix* Hartig.

Connold, Oak Galls, pl. 22; Plant Galls, fig. 186. Houard, No. 1214. Adler and Straton, Alternating Generations, pl. 1, fig. 10.

" On the male catkin. Gall ovoid, brown, minute, about 2 mm. high, fixed to the base of the catkin, and covered with hairs 6 to 8 mm. long. The galls are often massed together on the catkin, and form a rounded or ovoid swelling about the size of a pea, entirely concealed in a covering of white or yellowish hairs.

ANDRICUS RAMULI Linn. 234

Connold, Oak Galls, pl. 14; Plant Galls, fig. 224. Houard, No. 1186. Adler and Straton, Alternating Generations, pl. 2, fig. 13*a*.

" In a bud, an ovoid gall, about 5 mm. high, terminating in a point. It is glabrous, greenish, with a reddish tint on the upper part, which shows above the bud; the broad base is buried in the bud. Within the fleshy covering there is a woody internal gall marked with longitudinal striae. In September or October the gall becomes detached; the external part dries up and exposes the internal gall. Imago, spring, III.

ANDRICUS RAMULI, form AUTUMNALIS 235

Syn. *Andricus autumnalis* Hartig; *Aphilothrix autumnalis* Hartig.

Connold, Oak Galls, pl. 23; Plant Galls, fig. 183. Houard, No. 1219. Adler and Straton, Alternating Generations, pl. 2, fig. 13.

Hymenoptera Slight fusiform swelling, about 2 to 3 mm. long, on the petiole or the midrib, glabrous, green. This gall much resembles those of *Andricus trilineatus* Hartig (see No. 228), which occur in similar situations, and the imagines are so much alike that, according to Adler, they cannot be distinguished with certainty. Imago, August or September, I.

ANDRICUS TESTACEIPES Hartig 236

Connold, Oak Galls, pl. 16; Plant Galls, figs. 196, 197. Houard, No. 1318. Adler and Straton, Alternating Generations, pl. 1, fig. 6*a*.

,, At the base of very young oaks and on twigs and branches which touch the ground. Galls gregarious, appearing as little red excrescences in longitudinal chinks in the bark, each assuming later the shape of an obtuse cone. The outer covering dries up at maturity and falls away, leaving a conical hard gall 5 to 6 mm. high and 4 to 5 mm. in diameter, marked with longitudinal striae extending from the base to the summit. Imago, March, III.

ANDRICUS TESTACEIPES, form SIEBOLDI 237

Syn. *Andricus Sieboldi* Hartig; *Aphilothrix Sieboldi* Hartig.

Connold, Oak Galls, pls. 27-30; Plant Galls, fig. 172. Houard, No. 1293. Adler and Straton, Alternating Generations, pl. 1, fig. 6.

,, Gall developed from a terminal bud, rounded, fleshy, smooth, yellowish tinted with reddish-brown, varying in size from that of a walnut to a small apple. In section showing numerous ovoid larval cavities, with the longer axis parallel to the branch which bears the gall. Imago, June or July, I. (Plate IV. 1.)

BIORRHIZA PALLIDA Oliv. 238

Syn. *Teras terminalis* Fab.; *Biorrhiza terminalis* Cam.

Connold, Oak Galls, pls. 56, 57; Plant Galls, fig. 174. Houard, No. 1262. Adler and Straton, Alternating Generations, pl. 2, fig. 17*a*.

,, On the subterranean roots, sometimes at a depth of 3 feet. Galls at first brownish-yellow, or reddish in parts; they occur on roots of all sizes; the surface is warty and substance fleshy. At maturity the gall is blackish-brown, of a woody consistency, and about the size of a pea or a cherry, and contains one or many larval cells. Often gregarious, sometimes welded together into a large mass. (Plate IV. 5.)

BIORRHIZA PALLIDA, form APTERA 239

Syn. *Biorrhiza aptera* Bosc; *Biorrhiza terminalis* Cam.

Connold, Oak Galls, pls. 31-34; Plant Galls, fig. 165. Houard, No. 1289. Adler and Straton, Alternating Generations, pl. 2, fig. 17.

Hymenoptera On buds on the bark of the lower part of the trunk, and on small twigs and branches growing therefrom. Gall rounded, 5 to 7 mm. in diameter, with a minute apical point; surface smooth and shining, white, becoming a beautiful reddish-pink, soft and juicy within. There is no internal gall. Imago, May and June, I. These galls are usually gregarious.

TRIGONASPIS MEGAPTERA Panzer 240

Syn. *Trigonaspis crustalis* Hartig.

Connold, Oak Galls, pls. 58, 69; Plant Galls, figs. 168, 175. Houard, No. 1280. Adler and Straton, Alternating Generations, pl. 2, fig. 18*a*.

" On the lower surface of the leaf, attached to a vein by a short slender stalk; gall kidney-shaped, average length 3 mm., at first pale green or yellowish, becoming more or less tinted with red. Imago, spring, III.

TRIGONASPIS MEGAPTERA, form RENUM 241

Syn. *Trigonaspis renum* Giraud; *Biorrhiza renum* Hartig.

Connold, Oak Galls, pl. 34; Plant Galls, fig. 199. Houard, No. 1343. Adler and Straton, Alternating Generations, pl. 2, fig. 18.

" Gall formed at the extremity of the terminal part of a lateral leaf-vein, the growth of which is arrested, and the leaf in consequence is often segmented to the midrib at that part. The gall is minute (2 mm. long), soft, fleshy, and yellowish-white. Imago, May, I. (Plate V. 8, *d.*)

NEUROTERUS ALBIPES Schrenck 242

Syn. *Spathegaster albipes* Schr.

Connold, Oak Galls, pl. 51; Plant Galls, fig. 214. Houard, No. 1346. Adler and Straton, Alternating Generations, pl. 1, fig. 2*a*.

" On the lower surface of the leaf, and attached to it by a small point, a rounded gall, 3 to 5 mm. in diameter, plane or concave, whitish or brownish on its lower surface, with minute central umbo on the upper, which is dull red or veined with red. The gall is either quite glabrous at maturity, or has a few short hairs on the margin of the upper surface. Usually gregarious. Imago, March, II. (Plate V. 9, *f.*)

NEUROTERUS ALBIPES, form LAEVIUSCULUS 243

Syn. *Neuroterus laeviusculus* Schrenck.

Connold, Oak Galls, pl. 47; Plant Galls, fig. 208. Houard, No. 1332. Adler and Straton, Alternating Generations, pl. 1, fig. 2.

" On the male catkin, a rounded gall about 5 mm. in diameter, juicy, reddish, when numerous causing the

catkin to resemble a bunch of red currants. Imago emerges in May or June. This gall also appears on the leaf; it is then greenish-yellow, rarely tinged red. On the upper surface of the leaf there is a slight rounded swelling with a central scar; the bulk of the gall is below. It becomes dry and rapidly shrivels at maturity. Imago, June, I. (Plate V. 1.) 244

NEUROTERUS BACCARUM Linn. 245

Syn. *Spathegaster baccarum* Linn.

Connold, Oak Galls, pl. 53; Plant Galls, figs. 215, 227. Houard, Nos. 1196, 1355. Adler and Straton, Alternating Generations, pl. 1, fig. 1*a*.

Hymenoptera On the lower surface of the leaf, a button-like gall, 4 to 5 mm. in diameter, below almost plane, glabrous and whitish, attached to the leaf by a short and slender stalk. The upper surface of the gall is conical, yellowish-white, and closely covered with purplish or brown hairs, often densely gregarious. Imago, March, II. (Plate V. 4, *a*.)

NEUROTERUS BACCARUM, form LENTICULARIS 246

Syn. *Neuroterus lenticularis* Oliv.

Connold, Oak Galls, pl. 48; Plant Galls, figs. 210, 352. Houard, No. 1336. Adler and Straton, Alternating Generations, pl. 1, fig. 1.

,, On the under surface of the leaf, a small spherical gall, not exceeding 6 mm. in diameter, white or yellowish, covered with white or brownish hairs, which fall away at maturity; often densely gregarious and deforming the leaves. Imago, July, I. (Plate V. 14.)

NEUROTERUS TRICOLOR Hartig 247

Syn. *Spathegaster tricolor* Hartig.

Connold, Oak Galls, pl. 54; Plant Galls, fig. 216. Houard, No. 1356. Adler and Straton, Alternating Generations, pl. 1, fig. 4*a*.

,, On the under surface of the leaf, a button-like gall, from 2-3 mm. in diameter, not exceeding 1·5 mm. in height. Its lower surface is plane or slightly convex, with a central short stalk; the upper surface of the gall is yellowish, with a prominent central papilla. The edges of the gall are not adpressed to the leaf, and both sides of it are sparsely covered with stellate reddish or brown hairs. Often densely gregarious. Imago, April or May, II. (Plate V. 4, *b*.)

NEUROTERUS TRICOLOR, form FUMIPENNIS 248

Syn. *Neuroterus fumipennis* Hartig.

Connold, Oak Galls, pl. 46; Plant Galls, fig. 207. Houard, No. 1338. Adler and Straton, Alternating Generations, pl. 1, fig. 4.

Hymenoptera A rounded pustule about 3 mm. in diameter, showing on both surfaces of the leaf, but a little less pronounced below; solitary, glabrous, pale green or brownish, marked with striae radiating from the central papilla. There is no internal gall. Imago, June, I. (Plate V. 8, *c*.)

NEUROTERUS VESICATOR Schl. 249

Syn. *Spathegaster vesicatrix* Schl.

Connold, Oak Galls, pl. 55; Plant Galls, fig. 218. Houard, No. 1353. Adler and Straton, Alternating Generations, pl. 1, fig. 3*a*.

,, On the under surface of the leaf, gall resembling a minute silk button, 2 to 3 mm. in diameter and about 1 mm. high. There is a well-defined depression on the upper part of the gall, which is brownish, veined with red, and covered with filiform silky hairs radiating from the depression to the margin. Often densely gregarious. Imago, March, II. (Plate V. 9, *e*.)

NEUROTERUS VESICATOR, form NUMISMATIS 250

Syn. *Neuroterus numismatis* Oliv.

Connold, Oak Galls, pl. 49; Plant Galls, fig. 212. Houard, No. 1340. Adler and Straton, Alternating Generations, pl. 1, fig. 3.

,, In the axillary and terminal buds and on the leaf margin. Gall cylindrical, about 4 mm. long, greenish-yellow, becoming tinted with red; the surface covered with little vesicular hairs, which give it a finely granulated appearance. Imago, May, I. (Plate XXII. 9.)

DRYOPHANTA VERRUCOSA Schl. 251

Syn. *Spathegaster verrucosus* Schl.

Connold, Oak Galls, pl. 42; Plant Galls, figs. 194, 217. Houard, No. 1349. Adler and Straton, Alternating Generations, pl. 2, fig. 16*a*.

,, On the midrib and lateral veins on the lower surface of the leaf, attached by a very short stalk. Gall spherical, markedly flattened at the poles, diameter 7 mm., height 5 mm.; green or brownish, shining, often tinted red, becoming hard. Scattered. Imago, October or November, I. (Plate XXII. 12.)

DRYOPHANTA VERRUCOSA, form DIVISA 252

Syn. *Dryophanta divisa* Hartig.

Connold, Oak Galls, pl. 42; Plant Galls, fig. 204. Houard, No. 1328. Adler and Straton, Alternating Generations, pl. 2, fig. 16.

,, In dormant adventitious buds of the trunk and branches. Gall very minute, about 2 mm. long, greenish-grey, pointed,

covered with long white hairs. Imago, May, I. (Plate XXII. 1.)

DRYOPHANTA SIMILIS Adler 253

Syn. *Spathegaster similis* Adler.

Connold, Oak Galls, pl. 52; Plant Galls, fig. 192. Houard, No. 1261. Adler and Straton, Alternating Generations, pl. 2, fig. 15*a*.

Hymenoptera On the under surface of the leaf, attached to the midrib or the lateral veins. Gall spherical, 8 to 10 mm. in diameter, red, often girdled with a series of large yellowish bands, which are often granulated. Internal cavity elongated. Imago, November or December, I. (Plate XXII. 3.)

DRYOPHANTA SIMILIS, form LONGIVENTRIS 254

Syn. *Dryophanta longiventris* Hartig.

Connold, Oak Galls, pl. 43; Plant Galls, fig. 205. Houard, No. 1322. Adler and Straton, Alternating Generations, pl. 2, fig. 15.

,, In dormant adventitious buds of the trunk and branches. Gall very minute, ovoid, 2 to 5 mm. high, rounded, slightly depressed at the top, at first red, becoming violet; covered with very short hairs, which give it a velvety appearance. Imago, May or June, I. (Plate XXII. 5.)

DRYOPHANTA TASCHENBERGI Schl. 255

Syn. *Spathegaster Taschenbergi* Schl.

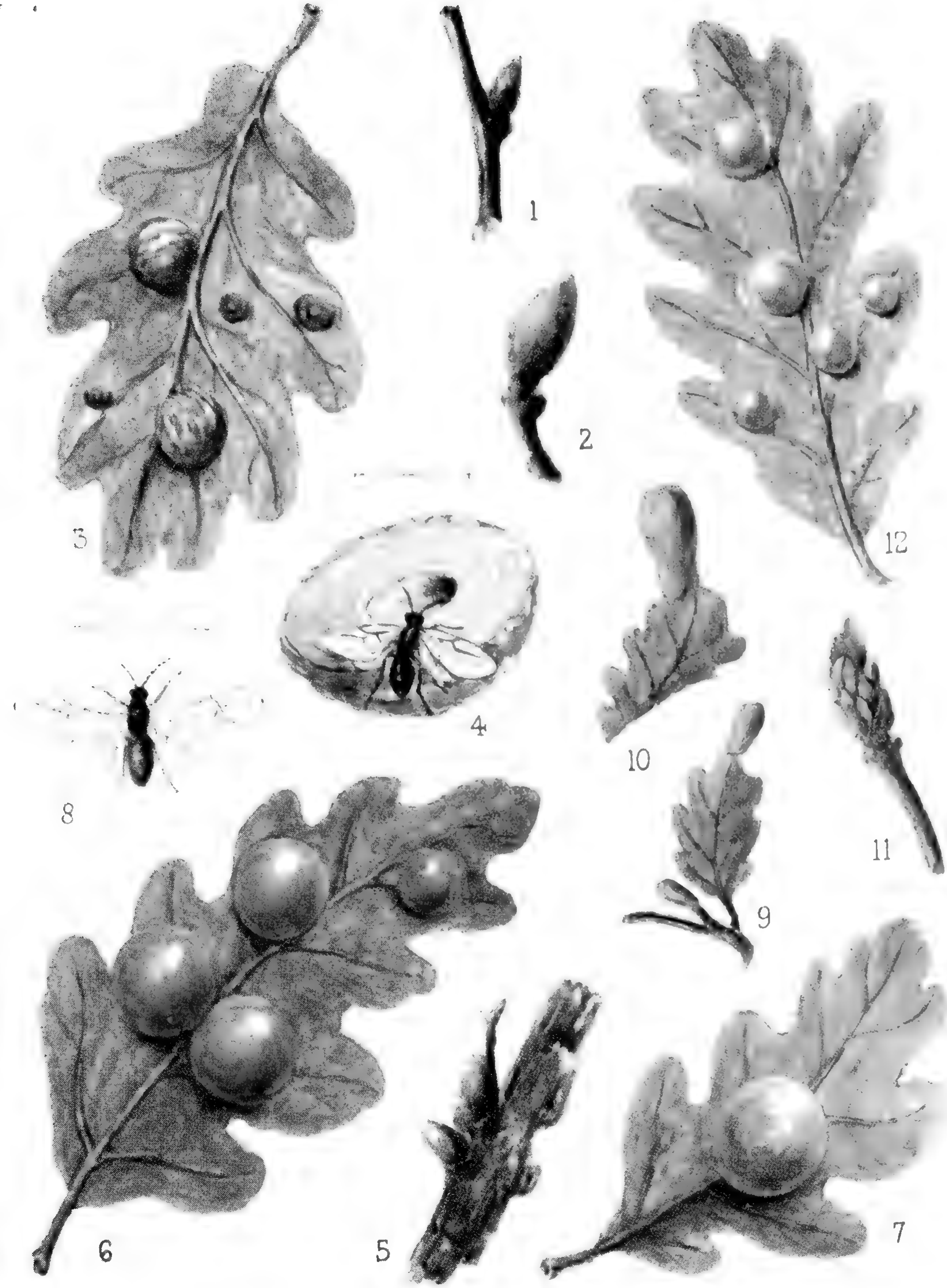
Connold, Oak Galls, pl. 52; Plant Galls, fig. 193. Houard, No. 1259. Adler and Straton, Alternating Generations, pl. 2, fig. 14*a*.

,, On the under surface of the leaf, attached to the midrib and the lateral veins. Gall large, spherical, 10 to 20 mm. in diameter, occasionally even 30 mm. in diameter, at first shining, fleshy, green or yellow, more or less tinted with red, smooth or rough, with little tubercles. After the departure of the insect it contracts and dries up. There is no internal gall. Solitary or gregarious. Imago, September to December, I., II. (Plate XXII. 6, 7.)

DRYOPHANTA TASCHENBERGI, form FOLII 256

Syn. *Dryophanta folii* Linn.; *Dryophanta scutellaris* Hartig.

Connold, Oak Galls, pls. 1, 44, 45; Plant Galls, fig. 206. Houard, No. 1320. Adler and Straton, Alternating Generations, pl. 2, fig. 14.



GALLS CAUSED BY WASPS (*Cynipidæ*) ON LEAVES AND BUDS OF THE COMMON OAK

II. Cynipidae of which the Corresponding Generations are as yet Unknown

(*a*) *Sexual Generation only*

Hymenoptera In the terminal buds, rarely in the axillary ones. The gall is formed by the welding into a mass 8 mm. high and 5 mm. in diameter of the internal swollen scales. Green, then brownish. There are small and scarcely deformed scales on the surface. Imago, April or May, I. Alternate generation of *Andricus ostreus* (?)

NEUROTERUS APRILINUS Giraud 257

Syn. *Spathegaster Aprilinus* Giraud.

Connold, Oak Galls, pl. 52; Plant Galls, fig. 191. Houard, No. 1215. Adler and Straton, Alternating Generations, pl. 2, fig. 19*a*.

„ On the male catkins. Gall ovoid, minute, 2 mm. high, 1 mm. in diameter, formed at the extremity of the filament of a stamen, on the side of which the anthers form two longitudinal swellings. Green at first, becoming brown and covered with short yellowish hairs. Imago, May, I.

ANDRICUS AMENTI Giraud 258

Connold, Oak Galls, pl. 5; Plant Galls, fig. 219. Houard, No. 1188.

„ In an axillary bud. Gall 3 to 5 mm. in diameter, inserted by a very short stalk and bearing a little umbo at its apex; the surface, which is slightly wrinkled and yellowish-brown, bears some short whitish hairs. The internal gall is quite round, and lies in the centre of a cavity in the spongy tissue. Imago, February or March, I.; October or November, II.

ANDRICUS CLEMENTINAE Giraud 259

Connold, Oak Galls, pl. 5; Plant Galls, fig. 176. Houard, No. 1279.

„ In an axillary or terminal bud. Gall green or reddish-brown, about 6 mm. long, swollen and rounded below, subcylindrical above. Entirely covered with a felt of long snow-white hairs. Imago, spring, II., III.

ANDRICUS GLANDULAE Schrenck 260

Connold, Oak Galls, pl. 10; Plants Galls, figs. 178, 179. Houard, No. 1256.

„ In an axillary bud; the cupule is sometimes affected also. Gall rounded, often attaining the size of a hazel nut, pale yellow, covered with very numerous projections, 4 to 8 mm. long. Each projection is slender, erect or slightly bent, and

bears at its apex a red and sticky papilla. Imago, March or April, II. Rare in Britain.

ANDRICUS LUCIDUS Hartig 261

Syn. *Aphilothrix lucida* Mayr. 262

Connold, Oak Galls, pl. 5; Plant Galls, fig. 180. Houard, Nos. 1172, 1226.

Hymenoptera In a terminal bud. Gall fusiform, about 10 mm. long, brown, covered with a felt of hairs of the same colour; its walls are woody and but slightly thickened. The hairs fall off when the gall arrives at maturity. Imago, September, I.

ANDRICUS SOLITARIUS Fonsc. 263

Connold, Oak Galls, pl. 15; Plant Galls, fig. 181. Houard, No. 1255.

(*b*) *Agamous Generation only*

, On the under surface of a leaf. Scattered. Gall hard, rounded, 2 to 3 mm. long, flattened at the poles; its larger axis is parallel to the midrib (or rarely a lateral vein), on which it is situated between two little valves, the remains of the membrane which enveloped the growth at an early stage. Green at first, then yellow, with red spots. Imago, October, I. Alternate generation of *Neuroterus Aprilinus* (?). (Plates I., II., IV.)

ANDRICUS OSTREUS Giraud 264

Connold, Oak Galls, pl. 50; Plant Galls, fig. 213. Houard, No. 1326. Adler and Straton, Alternating Generations, pl. 2, fig. 19.

, In an axillary bud. Gall solitary, elongated, subcylindrical, acorn-shaped, 4 to 5 mm. long, usually with a little recurved point at the apex, glabrous, entirely smooth, green with whitish bands, giving it a furrowed appearance longitudinally. Falls in May. Imago, spring, II., III.; or November, I.

ANDRICUS ALBOPUNCTATUS Sch. 265

Connold, Oak Galls, pl. 17, and fig. 7. Cameron considers this insect to be *A. quadrilineatus* attacking buds. Houard, No. 1284.

On the margin of a leaf. Solitary. Gall pyriform or fusiform, 3 to 4 mm. high, 2 to 3 mm. in diameter, green, longitudinally marked with red or yellowish-brown stripes. Imago, Spring, II.

ANDRICUS MARGINALIS Adler 266

Syn. *Aphilothrix marginalis* Schl.

Connold, Oak Galls, pl. 24; Plant Galls, fig. 198.

Houard, No. 1347. Adler and Straton, Alternating Generations, p. 90. Cameron considers *A. marginalis* to be *A. quadrilineatus* galling leaves, not a distinct species.

Hymenoptera On the male catkin. Gall unilocular, ovoid, about 3 mm. high and 2 mm. in diameter, glabrous, brown, its surface marked longitudinally with irregular striae, and terminating in a slightly marked umbo. Often abundant, sometimes more than thirty on one catkin.

ANDRICUS QUADRILINEATUS Hartig 267

Syn. *Aphilothrix quadrilineata* Hartig.

Connold, Oak Galls, pl. 13; Plant Galls, fig. 225. Houard, No. 1201. Adler and Straton, Alternating Generations, p. 91.

" On the male catkin. Gall unilocular, fusiform, 3 to 6 mm. long, attached to the axis of the catkin usually by a short stalk, green, more or less marked with longitudinal striae, its extremity marked with a minute umbo encircled by hairs more closely set at this point than elsewhere on the surface. The stalk of the catkin is much swollen at the point where the gall is seated. Imago, spring, II., III.

ANDRICUS SEMINATIONIS Adler 268

Syn. *Aphilothrix seminationis* Giraud.

Connold, Oak Galls, pl. 24; Plant Galls, fig. 226. Houard, No. 1200. Adler and Straton, Alternating Generations, p. 87.

" On the lower surface of the leaf. Solitary or scattered. Gall ovoid, 4 mm. long, at first yellowish white, becoming yellowish-brown. Attached by a very short, stout stalk to the midrib or a lateral vein. Surface glossy, slightly nodular. Imago, October or November, I.

DRYOPHANTA AGAMA Hartig 269

Connold, Oak Galls, pl. 40; Plant Galls, fig. 201. Houard, No. 1327.

" On the under surface of the leaf. Solitary or scattered. Gall spherical, markedly flattened at the poles, 4 to 5 mm. high; there is a slight depression at the upper pole, with a wart in the centre, slightly shining, yellow. Firmly attached by a small stalk to the midrib or a lateral vein. There are two cavities within; the larva occupies the lower. Imago, October or November, I.

DRYOPHANTA DISTICHA Hartig 270

Connold, Oak Galls, pl. 41; Plant Galls, fig. 202. Houard, No. 1329.

Hymenoptera Appearing below buds on the twigs and branches. Gall spherical, 12 to 23 mm. in diameter, at first green, then yellow, finally brown, often sprinkled with little nodosities. Its parenchyma is yellowish-brown, firm, but easily cut with a knife. It appears from the side of a bud which remains intact. Solitary, gregarious or coalescent. Imago appears in August or September. Said (by Beyerinck) to be the alternate generation of *Andricus circulans*. (Text, Fig. 4.)

CYNIPS KOLLARI Hartig 271, 272

Connold, Oak Galls, pls. 35-39; Plant Galls, fig. 190. Adler and Straton, Alternating Generations, p. 163. Houard, Nos. 1248, 1263.

,, Cupule affected. Gall the shape of a truncated cone, 15 to 20 mm. high, fixed to the cupule by a broad base 25 mm. in diameter; substance woody, coloured like the cupule. Its surface is marked with 5 to 8 keels, often interrupted by depressions; those at the apex surround a circular hole giving access to a chamber—below which is another cavity, entirely closed, containing the internal gall and larva. Imago, February or March, II. This gall has been recorded from Jersey, Channel Islands, but not from the United Kingdom.

CYNIPS CALICIS Burgsdorff 273

Connold, Oak Galls, pl. 61; Plant Galls, fig. 344. Houard, No. 1180.

,, Acorn attacked. Membrane slightly swollen, several little rounded galls within. Sometimes the development of the acorn is arrested, and it scarcely appears above the cupule. M. G. Imago in spring, I., II., III., IV.

CALLIRHYTIS GLANDIUM Giraud 274

Syn. *Andricus glandium* Giraud; *Andricus rufescens* Mayr.

Connold, Oak Galls, pl. 9. Houard, No. 1168.

III. AGENTS OTHER THAN CYNIPIDAE

Lepidoptera Woody nodosities in young branches and shoots.

PAMMENE SPLENDIDULANA Guenée 275

Syn. *Coccyx splendidulana* Entom. Syn. List.

Houard, No. 1303.

Lepidoptera Near the extremity of a branch, a more or less incurved swelling, two or three times the normal diameter of the branch. Caterpillar in the pith. Exit below.

STENOLECHIA GEMMELLA Linn. 276

Houard, No. 1300.

,, On the leaf. The midrib swollen, 5 to 8 mm. long, colour yellowish, also on petiole, the affected part attaining three times the normal diameter. Caterpillar white sprinkled with brown hairs, head black. M. E., rarely M. G.

HELIOZELA STANNEELLA Fisch. v. R. 277

Houard, No. 1316.

Diptera Terminal internodes not expanding, the leaves forming loose tufts, crinkled along their swollen veins. Larvae whitish, gregarious, leaping.

CONTARINIA QUERCINA Rüb. 278

Trail, Scottish Nat., iv., 1877. Houard, No. 1207.

,, One or more of the marginal lobes of the leaf thickened, folded downwards and flattened upon the lower surface, forming a pouch which is reddish above and spotted with red and yellow below. Larvae gregarious, two to six, whitish. (Plate VIII. 9, 10.)

MACRODIPLOSIS DRYOBIA F. Löw 279

Syn. *Diplosis dryobia* F. Löw.

Houard, No. 1306.

, The edges of the leaf segments folded over on the upper surface; within each fold are one to four pale orange-yellow larvae. There is no marked discoloration of the affected parts.

MACRODIPLOSIS VOLVENS Kieffer 280

Syn. *Cecidomyia roboris* Hardy.

Connold, Oak Galls, pl. 63; Plant Galls, fig. 200, and in both wrongly attributed to *M. dryobia.* Trail, in Wild Fauna and Flora of Kew Gardens, 1906, p. 44. Houard, No. 1307.

Acari On the lower surface of the leaf, adjacent to the larger vein, a felt of abnormal hairs of two kinds: one hyaline, very long and much contorted; the other shorter and cylindrical, scarcely bent, and often swollen into a club at the top. *Erineum quercinum* Persoon.

ERIOPHYES QUERCINUM Can. 281

Trail, in Wild Fauna and Flora of Kew Gardens, 1906, p. 44. Houard, No. 1313.

Homoptera Leaf margin folded downwards, scarcely swollen. Aphis oval, pale green or yellow, with very short green cornicles.
CALLIPTERUS QUERCUS Kalt. 282
Buckton, iii., p. 21. Houard, No. 1628.

,, Minute swelling on the upper surface of the leaf; a rounded depression below, about 1 mm. in diameter.
TRIOZA REMOTA Förster 283
Houard, No. 1312.

,, In the bark of the twigs. Little circular pits, 2 mm. in diameter, surrounded by an elevated circle of bark, single, gregarious or coalescent. May to July.
ASTERODIASPIS QUERCICOLA Bouché 284
Syn. *Asterolecanium variolosum* Rtz., *Coccus variolosum* Rtz.
Connold, Oak Galls, pl. 62; Plant Galls, fig. 173. Houard, No. 1299.

? Rounded swellings in the bark, chiefly of saplings, which attain the size of a hen's egg, and then crack and become deeply fissured and cankered, sometimes attaining large dimensions.
284*a*
Connold, Oak Galls, pls. 65, 66; Plant Galls, fig. 167.
Attributed to the fungus *Dichaena quercina*, but probably resulting from the attacks of insects.

Quercus cerris Linn. Turkey Oak.

Hymenoptera Oval gall, not exceeding 5 mm. in height, seated in the centre of a bud, surface smooth and shining, yellowish-brown or red. Sometimes gregarious, five to six in a bud. Imago, March to May, I. According to Beyerinck, the alternate generation of the marble gall-causer, *Cynips Kollari*. (Text, Fig. 5.)
ANDRICUS CIRCULANS Mayr. 285
Connold, Oak Galls, pl. 5. Houard, No. 1840.

,, Staminate catkin deformed. A flower is changed into a hard urn-like structure, 15 mm. high, 10 mm. wide, with a wide collar above. Plurilocular. Usually the axis of the catkin is greatly swollen, the galls numerous, and grouped into a mass attaining 40 mm. in diameter. Imago, July, August, I. This gall has not been observed in Britain. Cameron, however, captured a female insect at Loch Lomond.
ANDRICUS AESTIVALIS Giraud 286
Connold, Oak Galls, pl. 5. Houard, No. 1811.

Hymenoptera Minute ovoid galls in dormant adventitious buds. See No. 255.

DRYOPHANTA TASCHENBERGI Schl. 287

Ormerod, 1877, pp. 42, 43.

„ Acorn containing numerous larval cells. See No. 274.

CALLIRHYTIS GLANDIUM Giraud 288

Connold, Oak Galls, pl. 8. Houard, No. 1809.

Castanea sativa Mill. Sweet Chestnut.

Diptera Minute rounded pustule on the leaf, about 1 mm. in diameter, slightly raised on both surfaces, and of much brighter green than the surrounding normal tissue.

CECIDOMYIA sp. 289

C. Zimmermann, 1907. Houard, No. 1167.

Fagus sylvatica Linn. 67. Beech.

Hymenoptera On the roots, solitary or coalescent, yellowish or reddish-brown tumours, varying in size from a pea to a cherry. See No. 239.

BIORRHIZA APTERA Bosc. 290

Connold, Plant Galls, p. 137.

Diptera On the midrib or on the adjacent part of a lateral vein, on the upper surface of the leaf. A glabrous gall of woody consistency, ovoid but pointed, 8 to 10 mm. high, 5 mm. in diameter, with thick green walls. Green or tinted with red. On the lower surface of the leaf the gall is indicated by a slight rounded swelling with a minute central opening guarded by a fringe of hairs. Unilocular, larva white. M. E. Gall falls away at maturity.

MIKIOLA FAGI Hartig 291

Syn. *Hormomyia fagi* Hartig.

Connold, Veg. Galls, pl. 96; Plant Galls, fig. 51, his galls appear to be those of *Oligotrophus annulipes*. He describes them as being only 4 mm. in girth. Houard, No. 1151 (he does not allude to Connold's plate).

„ On the midrib or a lateral vein on the upper surface of the leaf. Gall soft, hairy, ovoid, bluntly pointed, 1 to 2 mm. in diameter, walls thin and fragile, covered with white or brown hairs. Unilocular, becoming detached at maturity, leaving a circular scar on the leaf. Larva white. M. E. (Plate IX. 1.)

OLIGOTROPHUS ANNULIPES Hartig 292

Syn. *Hormomyia piligera* F. Löw, *Hormomyia annulipes* Hartig.

Connold, Veg. Galls, pl. 98; Plant Galls, fig. 52. Houard, No. 1153.

Homoptera — Leaves folded and bent along the lateral nervures, blistered on the upper surface, the depression below containing the woolly Aphides. Aphis bright green or yellowish-green with large red eyes; the cornicles are mere tubercles.

PHYLLAPHIS FAGI Linn. 293

Connold, Plant Galls, fig. 346. Buckton, iii., p. 38. Houard, No. 1161.

Acari — Densely tufted mass of short twigs on the branches and on the trunk. Those on the branches sometimes resemble a "witch's broom." (Plate XIV.)

? ERIOPHYES 294

Swanton, Haslemere Mus. Gaz., i., p. 534.

,, — Tufts of short thick hairs, forming more or less rounded spots on the lower surface of the leaf. White at first, then rosy, finally brown. *Erineum fagineum* Persoon.

ERIOPHYES NERVISEQUUS Can., var. MACULIFER Trotter 295

Greville, 1827, pl. 250, vol. v. Houard, No. 1164.

,, — Leaf margin more or less rolled upwards, the interior of the roll lined with hairs. Sometimes the lateral veins are swollen, the leaf folded, covered with abnormal hairs, and tinted with red. *Legnon circumscriptum* Bremi.

ERIOPHYES STENASPIS Nalepa 296

Connold, Plant Galls, fig. 50. Houard, Nos. 1159, 1160. 297

,, — Leaf folded longitudinally, with a mass of abnormal hairs in the axils of the nervures on the lower surface. A discoloured swelling on the upper surface.

MONOCHETUS SULCATUS Nalepa 298

Connold, Veg. Galls, pl. 72; Plant Galls, fig. 53. Houard, No. 1163.

? — Branches much cankered and hypertrophied; the swellings are often tumour-like and large.

299

Connold, Plant Galls, figs. 48, 49. Massee, Textbook of Plant Diseases, p. 127. At one time supposed to have been caused by *Nectria ditissima*; it is probable that it is induced by Aphides.

LEAVES OF THE WYCH ELM (*Ulmus glabra*) WITH GALLS CAUSED BY THE PRESENCE OF THE LARVAE OF THE GALL-GNAT *Oligotrophus Leemei.* A, YOUNG LEAVES MUCH DISTORTED AND SWOLLEN; B, UPPER SURFACE SHEWING EXIT HOLES; C, LOWER SURFACE WITH GALLS IN A LATERAL POSITION ON THE MID-RIB

ULMACEAE

Ulmus glabra Huds. (*montana* Stokes). 99. Wych Elm.

Diptera Midrib of the leaf much swollen. The gall usually appears as a rounded, hard, yellowish-green swelling on the under surface, and a cylindrical projection on the upper one, with the aperture at its apex; but not infrequently the aperture is on the lower surface at right angles to the swollen midrib. When young shoots are attacked the leaves are much distorted. Larva solitary, greenish-yellow. M. E. Imago, April, II. (Plate XXIII.)

OLIGOTROPHUS LEMEEI Kieffer 300

Swanton, Knowledge, June, 1910. Houard, No. 2061.

Homoptera Ovoid swelling on the midrib just above the petiole, 10 to 14 mm. high 7 to 10 mm. in diameter, covered with serrated white hairs, yellowish. The leaf is more or less deformed, and the midrib is incurved below the point of attack. July and August. Aphis white or pale yellow.

PEMPHIGUS PALLIDUS Halliday 301

Syn. *Pemphigus ulmi* Halliday.

Connold, Plant Galls, fig. 108. Buckton, ii., 127. Houard, No. 2062.

" Leaf margin swollen, puckered, and rolled loosely inwards; very rarely both halves of the blade are attacked and incurved. Greenish-yellow, tinted with red. June to October. Aphis covered with cotton-like fibres.

SCHIZONEURA ULMI Linn. 302

Connold, Veg. Galls, pl. 107; Plant Galls, fig. 109. Houard, No. 2067.

Fungi Blisters or swollen patches on the leaves. The patches are dark green at first, then blackish-brown, and often cover a large area of the leaf.

TAPHRINA ULMI Johans. 303

Massee, Textbook of Plant Diseases, p. 92.

Ulmus campestris Linn. (*surculosa* Stokes). 60. Common Elm.

Homoptera On the upper surface of the leaf. An elongated or subglobose glabrous gall, 10 to 12 mm. high; pale green, purple or reddish above, with an apical opening, which, together with the neck of the gall, is surrounded with white hairs. The leaf is discoloured and somewhat thickened around the gall. Solitary or gregarious. June to September.

Aphis shining, dark green or black, globular. (Text, Fig. 21*b*.)

TETRANEURA ULMI De Geer 304

Connold, Veg. Galls, pl. 108; Plant Galls, fig. 107. Houard, No. 2048.

Homoptera — Leaf margins folded upwards, midrib much swollen, yellowish-green, aperture on the upper surface. Lateral veins slightly swollen. June to October.

TETRANEURA ALBA Ratzeburg 305

Connold, Veg. Galls, pl. 108; Plant Galls, fig. 106.

,, — Leaf margin swollen and rolled inwards. See No. 302 and Text, Fig. 21*a*.

SCHIZONEURA ULMI Linn. 306

Buckton, ii., 100. Houard, No. 2050.

,, — Leaf completely deformed and hypertrophied, dilated and contorted to form a densely hairy bladder, 60 to 80 mm. in diameter. Green at first, slowly becoming brown, and remaining attached to the branch after the normal hairs have fallen. Aphis black, clothed with cottony filaments.

SCHIZONEURA LANUGINOSA Hartig 307

Connold, Plant Galls, fig. 105. Buckton, iii., 104. Houard, No. 2051.

,, — Midrib of leaf swollen. See No. 301.

PEMPHIGUS PALLIDUS Halliday 308

Buckton, iii., 127.

Acari — Minute pustule, about 1 mm. in diameter, on the upper surface of the leaf, opening on the lower surface in a minute cylindrical protuberance. Green and red; often very numerous.

ERIOPHYES ULMI Nalepa 309

Houard, No. 2053.

Fungi — Dense mass of twigs on a branch, forming a "witch's broom." The leaves on the abnormal twigs are atrophied.

EXOASCUS TURGIDUS Sad. 310

Swanton, Haslemere Mus. Gaz., i., 531. Connold, Plant Galls, p. 95.

,, — Leaves blistered. See No. 303.

TAPHRINA ULMI Johans. 311

Massee, Textbook of Plant Diseases, p. 92.

URTICACEAE

Urtica dioica Linn. 112. Great Nettle.

Diptera — Unilocular, rounded, greenish-white swelling, 3 to 8 mm. in diameter, usually at the base of the leaf, with an elongated aperture on the upper surface; becoming violet at maturity. Sometimes occurring on the stem and the flower stalks. Larva white. M. E.

PERRISIA URTICAE Perris 312

Syn. *Dasyneura urticae* Perris.

Connold, Veg. Galls, pl. 90; Plant Galls, fig. 101. Houard, No. 2095.

Homoptera — At the extremity of a branch. A bunch of leaves with involuted margins.

APHIS URTICAE Fabr. 313

Buckton, ii., 50. Houard, No. 2094.

" — Leaves deformed and curled.

TRIOZA URTICAE Linn. 314

Connold, Plant Galls, fig. 162. Houard, No. 2097.

Fungi — Elongated swellings on the stems, with much thickening and distortion. The orange-yellow aecidiospores appear on roundish yellow spots thereon, also on the leaves. May and June. (Plate XVI. 2.)

Aecidial stage of PUCCINIA CARICIS Schum. 315

Syn. *Aecidium urticae* D. C.

Plowright, p. 169. Connold, Plant Galls, p. 257.

Urtica urens Linn. 108. Small Nettle.

Diptera — Swellings at the base of the leaf. See No. 312.

PERRISIA URTICAE Perris 316

Houard, No. 2099.

Homoptera — Leaves crumpled and deformed.

TRIOZA URTICAE Linn. 317

Houard, No. 2100.

POLYGONACEAE

Polygonum convolvulus Linn. 31. Black Bindweed.

Fungi — Blossom swollen, containing the dark violet mass of teleutospores. June to September.

USTILAGO UTRICULOSA Nees 318

Syn. *Ustilago utriculosa* Tulasne.

Plowright, p. 280.

Polygonum aviculare Linn. 111. Common Knot-grass.

Lepidoptera Buds swollen, conical or fusiform swelling at the extremity of the twig amongst the terminal leaves; tinted red, sometimes 15 mm. long and 3 mm. thick. Each gall contains a green caterpillar. (Plate VII. 1.)

AUGASMA AERATELLA Zell. 319

Syn. *Asychna aeratella* Zell. 320

Connold, Plant Galls, p. 145. Houard, No. 2153, 2154.

Polygonum hydropiper Linn. 105. Biting Persicaria.

Fungi Inflorescence swollen. See No. 318.

USTILAGO UTRICULOSA Nees 321

Plowright, p. 280.

Polygonum persicaria Linn. 112. Spotted Persicaria.

,, Inflorescence swollen. See No. 318.

USTILAGO UTRICULOSA Nees 322

Plowright, p. 280.

Polygonum lapathifolium Linn. 103. Pale-flowered Persicaria.

,, Inflorescence swollen. See No. 318.

USTILAGO UTRICULOSA Nees 323

Plowright, p. 280.

Polygonum amphibium Linn. 108. Water Persicaria.

Diptera Flowers deformed. Leaf margins rolled inwards, slightly serrated, much swollen and contorted; brightly coloured, orange, red, or purple. Larvae gregarious, red. M. G.

PERRISIA PERSICARIAE Linn. 324

Syn. *Dasyneura persicariae* Linn. 325

Connold, Veg. Galls, pl. 82. Plant Galls, fig. 246. Houard, No. 2157, 2159.

Polygonum bistorta Linn. 74. Snakeweed.

Fungi Thickened hemispherical spots on the leaves, containing the dark violet teleutospores. July and August.

USTILAGO BISTORTARUM D. C. 326

Syn. *Tilletia bullata* Fckl.

Plowright, p. 277.

Fagopyrum sagittatum Gilib. (*esculentum* Moench). Buckwheat.

Nematoda Stems swollen and twisted, internodes shortened and thickened, leaves often hypertrophied.

TYLENCHUS DEVASTATRIX Kühn 327

Connold, Plant Galls, p. 244. Houard, No. 2175.

Oxyria digyna Hill. 31. Mountain Sorrel.

Fungi — Inflorescence swollen, containing the very pale violet teleutospores.

USTILAGO VINOSA Berkeley 328

Syn. *Ustilago vinosa* Tulasne.
Plowright, p. 278.

Rumex conglomeratus Murr. 97. Sharp Dock.

Coleoptera — Fusiform swelling in the midrib of the leaf, containing a bright orange larva.

APION MINIATUM Germar 329

Houard, No. 2118.

Rumex pulcher Linn. 43. Fiddle Dock.

" — Fusiform swellings in the stem and lateral branches.

APION VIOLACEUM Kirby 330

Houard, No. 2125.

Rumex crispus Linn. 112. Curled Dock.

Homoptera — Margins of the leaf curled inwards and slightly swollen. Aphis wholly black. Larvae at first slate-grey, then blackish.

APHIS RUMICIS Linn. 331

Buckton, ii., 83.

Rumex Acetosa Linn. 112. Sorrel Dock.

Coleoptera — Somewhat rounded or subconical; hard, unilateral swelling on the floral stem, 1·5 to 2 by 2 to 4 mm., unilocular. Situated at a node or just above it, the internode always shortened.

APION AFFINE Kirby 332

Houard, No. 2137.

" — Fusiform swellings on the stem and lateral branches.

APION VIOLACEUM Kirby 333

Houard, No. 2138.

" — On the midrib of the leaf or on the petiole. A fusiform swelling, yellow or red, surrounded by a zone of darker colour, 10 mm. long, 5 mm. in diameter, containing an orange larva.

APION FRUMENTARIUM Linn. 334

Houard, No. 2132.

" — On the midrib or the petiole. Gall similar to that caused by the larva of *A. frumentarium*. See No. 334.

APION HUMILE Germar 335

Houard, No. 2133.

Rumex Acetosella Linn. 112. Sheep's Sorrel.

Coleoptera — On the roots and the subterranean part of the stem. Rounded swellings varying in size from a pea to a nut, each containing a white larva.

APION SANGUINEUM De Geer. 336

Houard, No. 2130.

,, — On the leaf. Swelling on midrib or the petiole. See No. 334.

APION FRUMENTARIUM Linn. 337

Houard, No. 2139.

,, — On the leaf. Midrib or petiole swollen. See No. 335.

APION HUMILE Germar 338

Houard, No. 2140.

CHENOPODIACEAE

Chenopodium album Linn. 112. White Goose-foot.

Homoptera — Leaf margin loosely revolute, hypertrophied and discoloured. Aphis (oviparous ♀) glaucous green, with two occipital smoky spots; larva variously coloured, from green to olive and black.

APHIS ATRIPLICIS Linn. 339

Houard, No. 2182.

Atriplex patula Linn. 93. Orache.

,, — Leaf deformed. Margins revolute, forming two hollow pods. Greenish-yellow at first, brown at maturity. June to September. See also No. 339.

APHIS ATRIPLICIS Linn 340

Connold, Veg. Galls, pl. 101; Plant Galls, fig. 233. Buckton, ii., 87. Houard, No. 2197.

,, — Leaf irregularly wrinkled at the margin.

TRIOZA ATRIPLICIS Licht 341

Syn. *Trioza chenopodii* Reut.

Scott, Ent. Mag., 1881, vol. xviii., p. 275. Houard, No. 2198.

Atriplex hastata Linn. 95. Halberd-leaved Orache.

,, — Leaf margin rolled upwards. See No. 339.

APHIS ATRIPLICIS L. 342

Houard, No. 2204.

CAROPHYLLACEAE

Silene latifolia, Rendle and Britten (*inflata* Sm.). 104. Bladder Campion.

Homoptera Summit of the plant curiously distorted and bunched. Aphis greenish with black head; mealy, cornicles very small, black. July and August. The aphides often crowd within the capsules.

HYALOPTERUS MELANOCEPHALUS Buckton 343

Buckton, ii., 116. Houard, No. 2264.

Silene acaulis Linn. 21. Cushion Pink.

Diptera On the stem. Terminal internodes remaining closed; leaves bunched very large and very thick, usually discoloured; almost white towards the base, green at the apex. Larvae gregarious, rosy-red. M. E.

PERRISIA ALPINA F. Löw 344

Houard, No. 2274.

Lychnis alba Miller. 103. White Campion.

,, Flower buds swollen, not opening. Larvae gregarious, white or yellowish. M. E., ii.

CONTARINIA STEINI Karsch 345

Houard, No. 2291. According to Collin (Ent. Mo. Mag., 1904, p. 96), this is apparently the insect of which the larvae and the galls caused thereby were described by Binnie in Proc. Glasgow N. H. Soc., 1876, p. 184; and the gall described by Barrett in Ent. Mo. Mag., 1872, vol. viii., p. 205, would appear to be caused by the larvae of a different species, possibly *Perrisia lychnidis* Heyd.

Cerastium vulgatum Linn. (*triviale* Link). 112. Narrow-leaved Mouse-ear.

,, The two terminal leaves joined along their margins and slightly thickened, forming a cavity for the reddish larvae. Occasionally the buds are attacked and become swollen. M. G. Imago appears in August or in the following spring.

PERRISIA LOTHARINGIAE Kieffer 346

Connold, Plant Galls, p. 95. Swanton, Knowledge, 347
June, 1910. Houard, Nos. 2331, 2334.

,, A mass of hairy reddish leaves at the extremity of a shoot with an oval cavity between them containing several orange-coloured larvae. M. G.

PERRISIA CERASTII Binnie 348

Syn. *Cecidomyia cerastii* Binnie.
Connold, Plant Galls, p. 244. Houard, No. 2338.

Homoptera — Margins of the terminal leaves rolled backwards, forming a pod. The leaves are swollen and sometimes loosely bunched together. Aphis elongated, yellow or shining black, mealy. May to July. M. G.

BRACHYCOLUS STELLARIAE Hardy 349

Syn. *Aphis holci* Hardy.
Buckton, ii., 148. Houard, No. 2339.

Stellaria Holostea Linn. 109. Greater Stitchwort.
Terminal leaves swollen and clustered. See No. 349.

BRACHYCOLUS STELLARIAE Hardy 350

Buckton, ii., 148. Houard, No. 2312.

Stellaria graminea Linn. 109. Lesser stitchwort.
,, — Terminal leaves clustered and swollen. See No. 349.

BRACHYCOLUS STELLARIAE Hardy 351

James Hardy, North Brit. Agriculturalist, pt. ii., p. 788. Buckton, ii., 148.

Sagina ciliata Fr. 68. Ciliated Pearlwort.
? — Entire plant deformed. Shoots transformed into an ovoid, purple, fleshy gall about 3 to 4 mm. thick.

352

Trail, 1904, p. 130. Houard, No. 2354.

Spergula arvensis Linn. 112. Corn Spurrey.
Nematoda — Stem thickened and distorted.

TYLENCHUS DEVASTATRIX Kühn 353

Bd. Agriculture Leaflet, No. 46.

RANUNCULACEAE

Clematis Vitalba Linn. 49. Traveller's Joy.
Fungi — Leaf stalk and young shoots swollen and considerably distorted. The swollen parts contain the yellow aecidiospores.

AECIDIUM CLEMATIDIS D. C. 354

Plowright, p. 265.

Thalictrum dunense Dum. 37. Meadow Rue.
,, — Fusiform swellings on the stems; thick, black pustules on the leaves containing the spore mass. June to August.

UROCYSTIS SOROSPORIOIDES Körn 355

Plowright, p. 287.

Thalictrum minus Linn. 36. Lesser Meadow Rue.

Diptera Fruit deformed, swollen and globular. Isolated galls are very inconspicuous. Larvae yellow. M. E. July, II.

CLINODIPLOSIS THALICTRICOLA Rüb. 356

Syn. *Cecidomyia thalictri* Trail.

Houard, No. 2441. According to Collin (Ent. Mo. Mag., May, 1904, p. 97), the gall mentioned by Trail in Proc. Ent. Soc. Lond. of September 7, 1881, and in Botan. Exch. Rep., 1883, p. 83, is apparently that of Rübsaamen's *Clinodiplosis thalictricola* (v. Kieffer, Ann. Soc. Ent. Fr., 1901, p. 526).

Fungi Fusiform swelling on the stem. See No. 355.

UROCYSTIS SOROSPORIOIDES Körn 357

Plowright, p. 287.

Thalictrum flavum Linn. 71. Common Meadow Rue.

Diptera Fruit deformed, swollen and globular. See No. 356.

CLINODIPLOSIS THALICTRICOLA Rüb. 358

Connold, Plant Galls, fig. 266. Houard, No. 2448.

Fungi Thickened spots on the leaves, purple-brown above, yellow below, containing the orange-yellow aecidiospores. May and June.

PUCCINIA PERSISTENS Plowright 359

Plowright, p. 180.

Anemone nemorosa Linn. 108. Wood Anemone.

Fungi Roundish or elongated swellings on the stems and midribs, containing the blackish-brown spore masses. July and August.

UROCYSTIS ANEMONES Persoon 360

Syn. *Urocystis pompholygodes* Lév. 361

Plowright, p. 288. Connold, Plant Galls, fig. 256.

Ranunculus acris Linn. 112. Upright Buttercup.

Diptera Leaflets thickened at the base and margins, the latter rolled back until they meet, forming a cylindrical pointed (sometimes reddish) receptacle for the gregarious red larvae. M. G. or M. E. Imago, June, II.

PERRISIA RANUNCULI Bremi 362

Syn. *Cecidomyia ranunculi* Bremi.

Houard, No. 2423.

Fungi Stem and midribs swollen. See No. 360. 363

UROCYSTIS ANEMONES Persoon 364

Plowright, p. 288.

Fungi — Rounded or fusiform swellings on the stem, becoming yellowish-brown. June to November.
ENTYLOMA MICROSPORUM Ung. 365
Syn. *Protomyces microsporus* Ung.
Plowright, p. 291.

Ranunculus repens Linn. 112. Creeping Buttercup.
Diptera — Leaflets thickened and rolled. See No. 362.
PERRISIA RANUNCULI Bremi 366
Fitch, 1880, p. 146. Connold, Veg. Galls, pl. 84. Plant Galls, fig. 255. Houard, No. 2431.

Fungi — Stems and midribs swollen. See No. 360.
UROCYSTIS ANEMONES Persoon 367
Plowright, p. 288. 368

,, — Stems swollen. See No. 365.
ENTYLOMA MICROSPORUM Ung. 369
Plowright, p. 291.

Ranunculus bulbosus Linn. 106. Bulbous Buttercup.
Diptera — Leaflets thickened and rolled. See No. 362.
PERRISIA RANUNCULI Bremi 370
Houard, No. 2438.

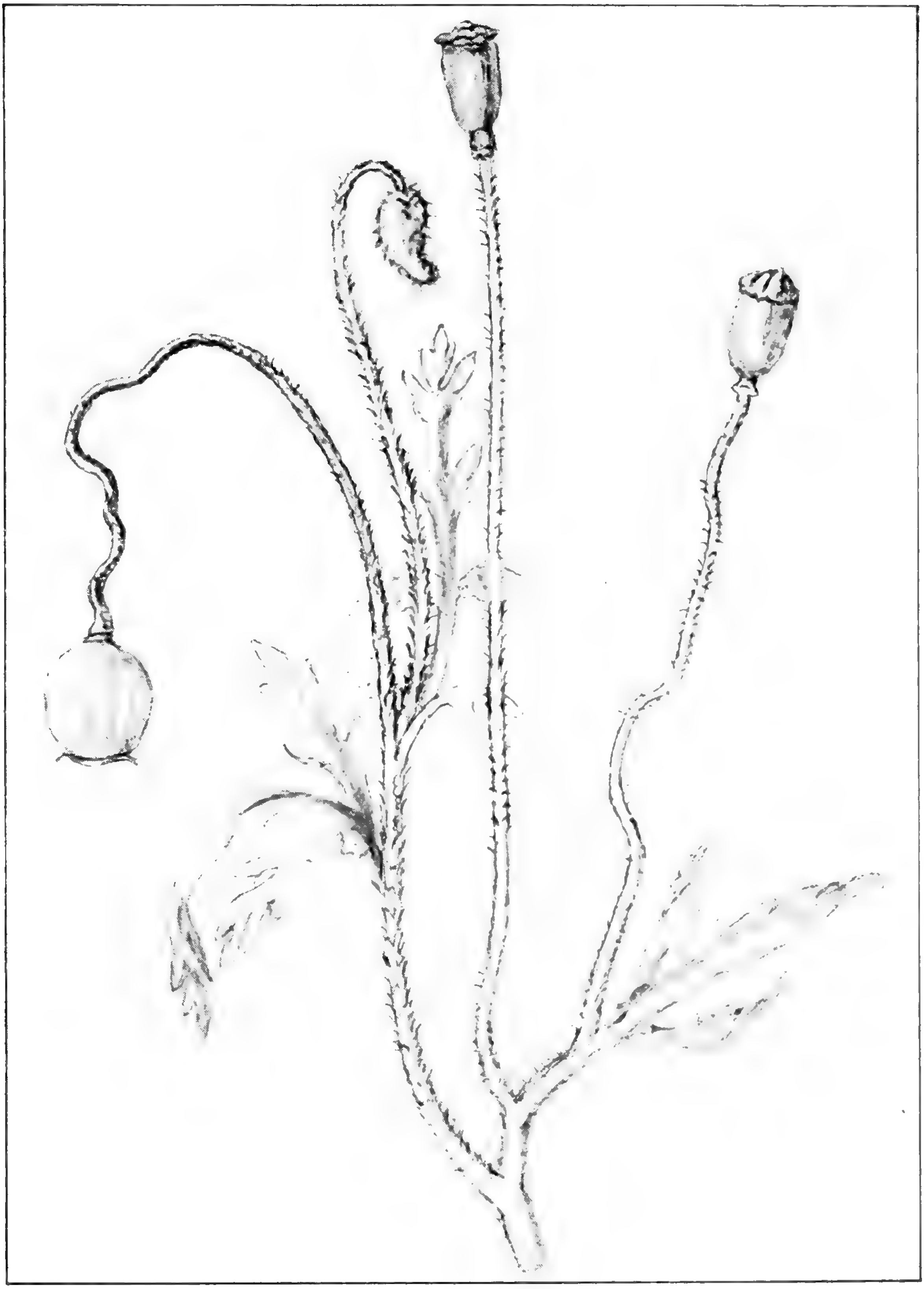
Fungi — Stems swollen. See No. 360.
UROCYSTIS ANEMONES Persoon 371
Plowright, p. 288.

Caltha palustris Linn. 112. Marsh Marigold.
Homoptera — Leaf margin deformed, atrophied, and discoloured.
APHALARA CALTHAE Linn. 372
Houard, No. 2365.

Fungi — Long swellings on the stems, containing the orange-coloured aecidiospores. May.
Aecidial stage of PUCCINIA CALTHAE Link 373
Syn. *Aecidium calthae* Greville.
Plowright, p. 145.

Aquilegia vulgaris Linn. 62. Common Celandine.
,, — Thickened round yellow spots on the leaves and elongated swelling on the stems, containing the orange aecidiospores.
AECIDIUM AQUILEGIAE Persoon 374
Plowright, p. 263.

PLATE XXIV



SEED CAPSULES OF THE COMMON POPPY (*Papaver Rhaeas*), THE SWOLLEN AND DROOPING ONE IS GALLED BY THE LARVAE OF *Aulax papaveris*

BERBERIDACEAE

Berberis vulgaris Linn. 86. Common Barberry.
Fungi — Swollen spots on the leaves, reddish above, yellow below, containing the orange aecidiospores. May to July.
Aecidial stage of PUCCINIA GRAMINIS Pers. 375
Syn. *Accidium berberidis* Pers.
Plowright, p. 162.

PAPAVERACEAE

Papaver Rhaeas Linn. 106. Common Poppy.
Hymenoptera — Capsules more or less swollen and deformed, interior divisions destroyed, containing numerous larval cells (ten to sixty). M. G. May, II.
AULAX PAPAVERIS Perris 376
Syn. *Aulax rhaeadis* May.
Connold, Veg. Galls, pl. 128; Plant Galls, fig. 251. Houard, No. 2477.

Diptera — Capsules swollen, containing numerous larvae. M. G.
PERRISIA PAPAVERIS Winn. 377
Syn. *Cecidomyia papaveris*, Wtz.
Connold, Plant Galls, p. 246. Houard, No. 2479.

Papaver dubium Linn. 105. Long Smooth-headed Poppy.
Hymenoptera — Capsules swollen. See No. 376 and Plate XXIV.
AULAX PAPAVERIS Perris 378
Connold, Veg. Galls, pl. 128; Plant Galls, fig. 251. Houard, No. 2481.

CRUCIFERAE

Matthiola incana Br. 4. Hoary Stock.
Coleoptera — Tubercles on the stem.
BARIS LATICOLLIS Marsh 379
Houard, No. 2740.

Cheiranthus cheiri Linn. Common Wallflower.
,, — Fleshy rounded swellings, about the size of a pea, situated on the upper part of the root.
CEUTHORRHYNCHUS PLEUROSTIGMA Marsh 380
Syn. *Ceuthorrhynchus sulcicollis* Gyll., nec Payk.
Houard, No. 2725.

Myce-tozoa Nodular or warty outgrowths on the roots, which become swollen and clubbed. The well-known 'finger and toe' disease.

PLASMODIOPHORA BRASSICAE Woronin 381

Connold, Plant Galls, p. 227.

Radicula sylvestris Druce (*Nasturtium sylvestre* Br.). 64. Yellow Watercress.

Diptera Large ovoid spongy swelling at the base of the leaf stalk. Flowers much deformed and swollen, forming a globular, spongy, yellowish mass about 12 mm. across. Larvae yellow, gregarious. M. G.

DASYNEURA SISYMBRII Schrank 382

Syn. *Cecidomyia sisymbrii* Sch. 383

Connold, Plant Galls, figs. 307, 308. Houard, No. 2648.

Radicula palustris Moench (*Nasturtium palustre* D. C.). 84. Marsh yellow Cress.

,, Inflorescence and stem swollen. June to November. See Nos. 382, 383.

DASYNEURA SISYMBRII Schrank 384

Houard, No. 2652.

Barbarea vulgaris Ait. 102. Yellow Rocket.

,, Flower stalks, inflorescence, leaves and petioles, de- 385
formed and swollen. May and June. See Nos. 382, 383. 386
DASYNEURA SISYMBRII Sch. 387
Connold, Plant Galls, fig. 326. Houard, Nos. 2640-2643. 388

Cardamine amara Linn. 76. Large-flowered Bitter-cress.

Coleop-tera On the stem, usually at the base, a unilateral feeble swelling, resulting from hypertrophy of the cortical parenchyma, containing a larval cavity. Small, and easily overlooked.

PSYLLIOIDES NAPI Koch 389

Houard, No. 2673.

Diptera Flowers not opening. Calyx normal; the unopened corolla consists of green petals with swollen bases, the stamens and filaments shortened and thickened. Larvae red, about six in a gall. M. E.

PERRISIA CARDAMINIS Winn. 390

Syn. *Cecidomyia cardaminis* Wtz.

Inchbald, 1883, p. 194. Houard, No. 2672.

Cardamine pratense Linn. 112. Cuckoo Flower.

Coleop-tera Irregular axial swelling and elongated distortion of the stem, very variable in size and shape. The leaf stalk is

sometimes distorted in a similar manner. Numerous larval burrows within.

CEUTHORRHYNCHUS PECTORALIS Schult 391

Connold, Plant Galls, fig. 66. Houard, No. 2668.

Coleoptera — Slight swelling on the lower part of the stem. See No. 389.

PSYLLIOIDES NAPI Koch 392

Houard, No. 2669.

Diptera — Flowers remaining closed, forming a globular gall. See No. 390.

PERRISIA CARDAMINIS Winn. 393

Connold, Plant Galls, fig. 67. Houard, No. 2665.

Fungi — Floral leaves greatly hypertrophied. Stem and flowers much distorted and swollen, affected parts snow-white, appearing as if polished at the time when the conidia are forming beneath the epidermis; upon the rupture of the latter the free conidia appear on the surface as a white powder. The well-known "white rust."

CYSTOPUS CANDIDUS Lév. 394

Syn. *Albugo candida* Lév. 394a

Massee, Textbook Pl. Diseases, p. 59. 394b

Cardamine hirsuta Linn. 110. Hairy Bitter Cress.

Coleoptera — Irregularly subglobose, unilocular, small, fleshy swellings on the petioles of the radical leaves.

CEUTHORRHYNCHUS CONTRACTUS Marsh 395

Houard, No. 2657.

Erophila verna E. Meyer (=*Draba verna* L.). 109. Common Whitlow Grass.

,, An ovoid swelling at the base of the stem, containing a single white larva. M. E. (Plate VI. 4.)

CEUTHORRHYNCHUS HIRTULUS Germar 396

Connold, Plant Galls, p. 246. Houard, No. 2688.

Cochlearia armorica Linn. Horse Radish.

,, Rounded swelling on the upper part of the root.

CEUTHORRHYNCHUS PLEUROSTIGMA Marsh 397

Houard, No. 2510.

Hesperis matronalis Linn. Dame's Violet.

,, Seed-pod (siliqua) swollen.

CEUTHORRHYNCHUS INAFFECTATUS Gyllh. 398

Houard, No. 2737.

Homoptera — Leaf margin rolled upwards. See No. 410.
APHIS BRASSICAE Linn. 399
Houard, No. 2739.

Sisymbrium officinale Scop. 111. Hedge Mustard.

Coleoptera — Seed-pod swollen.
CEUTHORRHYNCHUS ASSIMILIS Payk. 400
Connold, Plant Galls, p. 245. Ormerod, p. 156.

" Unilocular ovoid swelling, 7 to 8 mm. long, 4 mm. in diameter, on the petiole or the midrib, dull green, axial, sometimes lateral. M. E.
CEUTHORRHYNCHUS CHALYBAEUS Germar 401
Houard, No. 2522.

Fleshy excrescences each about the size of a pea, at the base of the stem.
CEUTHORRHYNCHUS PLEUROSTIGMA Marsh 402
Houard, No. 2519.

Diptera — Inflorescence deformed; the flower-stalks swollen, forming a fleshy or spongy mass, from which the crowded seed-pods arise in a peculiar spicate manner. Larvae gregarious, white. M. E.
CONTARINIA RUDERALIS Kieffer 403
Houard, No. 2516.

" Inflorescence deformed. See Nos. 382, 383.
DASYNEURA SISYMBRII Schrank 404
Connold, Veg. Galls, pl. 29; Plant Galls, fig. 160. Houard, No. 2517.

Sisybrium Sophia Linn. 64. Flix-weed.

Coleoptera — Root swollen at its apex. See No. 402.
CEUTHORRHYNCHUS PLEUROSTIGMA Marsh 405
Houard, No. 2539.

Diptera — Inflorescence deformed. June to November. See Nos. 382, 383.
DASYNEURA SISYMBRII Sch. 406
Houard, No. 2538.

Erysimum cheiranthoides Linn. 38. Treacle Mustard.

Coleoptera — Root swollen at the junction with stem. See No. 402.
CEUTHORRHYNCHUS PLEUROSTIGMA Marsh 407
Houard, No. 2716.

Brassica oleracea. Cabbage.

Coleoptera Irregularly globular swellings, 12 mm. to 15 mm. across, at the base of the stem, solitary or coalescent. Each containing a single white larva. M. E. Spring, II.
CEUTHORRHYNCHUS PLEUROSTIGMA Marsh 408
Syn. *Ceuthorrhynchus sulcicollis* Gyll., nec Payk.
Connold, Plant Galls, p. 90. Ormerod, p. 35.

Diptera Large irregular swellings and mammillated protuberances on the root and rootlets, coalescing when numerous.
PHORBIA BRASSICAE Bouché 409
Syn. *Anthomyia brassicae* Bouché.
Connold, Plant Galls, p. 90. Ormerod, p. 25.

Homoptera Discoloured blisters and wrinkles on the upper surface of the leaf. Aphides congregate below. Aphis greyish-green with black spots, covered with a whitish mealy coat. Larvae at first oval, shining, bright yellow.
APHIS BRASSICAE Linn. 410
Buckton, ii., 34. Houard, No. 2578.

Nematoda Lateral swellings on the slender root fibres. The eelworms live on the surface of the galls ; there is no internal cavity.
HETERODERA SCHACHTII Schmidt 411
Connold, Plant Galls, p. 75.

Fungi Swollen white patches on stems, leaves, etc. See No. 394.
CYSTOPUS CANDIDUS Lév. 412
Massee, Textbook of Plant Diseases, p. 59.

Mycetozoa Roots swollen. See No. 381.
PLASMODIOPHORA BRASSICAE Wor. 413
Massee, Textbook of Plant Diseases, p. 334.

Brassica napus Linn. Rape.

Coleoptera Root swollen. See No. 402.
CEUTHORRHYNCHUS PLEUROSTIGMA Marsh 414
Connold, Veg. Galls, pl. 8. Houard, No. 2597.

Diptera Seed-pod slightly swollen, tenanted by numerous non-leaping larvae. M. E.
DASYNEURA BRASSICAE, Winn. 415
Syn. *Cecidomyia brassicae* Winn.
Houard, No. 2591.

„ Root swollen. See No. 409.
PHORBIA BRASSICAE Bouché 416
Connold, Plant Galls, fig. 299.

Myce-tozoa Root swollen. See No. 381.
PLASMODIOPHORA BRASSICAE Wor. 417
Connold, Plant Galls, fig. 300.

Brassica Rutabaga D. C. Swedish Turnip or Swede.

Coleop-tera Root swollen. See No. 402.
CEUTHORRHYNCHUS PLEUROSTIGMA Marsh 418
Connold, Veg. Galls, pls. 9, 10; Plant Galls, fig. 298.

Diptera Root swollen. See No. 409.
PHORBIA BRASSICAE Bouché 419

" Seed-pods swollen. See No. 415.
DASYNEURA BRASSICAE Winn. 420

Myce-tozoa Roots swollen. See No. 381.
PLASMODIOPHORA BRASSICAE Wor. 421
Massee, Textbook of Plant Diseases, p. 334.

Brassica rapa Linn. Common Turnip.

Coleop-tera Hemispherical galls near the top of the root. See No. 402.
CEUTHORRHYNCHUS PLEUROSTIGMA Marsh 422
Houard, No. 2586.

Diptera Root swollen. See No. 409.
PHORBIA BRASSICAE Bouché 423
Ormerod, p. 25.

Homop-tera Leaf puckered and swollen. See No. 410.
APHIS BRASSICAE Linn. 424
Houard, No. 2589.

Nematoda Roots swollen. See No. 411.
HETERODERA SCHACHTII Schmidt 425
Houard, No. 2587.

Brassica arvensis O. Kuntze (*sinapistrum* Boiss). Charlock.

Coleop-tera Solitary, gregarious or coalescent swellings, each about the size of a pea near the top of the root, just below the ground, with a single larva in each. M. E.
CEUTHORRHYNCHUS ASSIMILIS Payk 426
Connold, Veg. Galls, pl. 11; Plant Galls, fig. 87. Houard, No. 2605.

Galls resembling those of the preceding.
CEUTHORRHYNCHUS PLEUROSTIGMA Marsh 427
Houard, No. 2606.

Coleoptera — Galls resembling those of the preceding.
CEUTHORRHYNCHUS CONTRACTUS Marsh 428
Kirby and Spence, 1828, p. 188. Houard, No. 2607.

Homoptera — Floral axis thickened, flowers greenish. See No. 410.
APHIS BRASSICAE Linn. 429
Buckton, ii., 34. Houard, No. 2601.

Nematoda — Roots swollen. See No. 411.
HETERODERA SCHACHTII Schmidt 430
Connold, Plant Galls, p. 75.

Capsella Bursa-pastoris Medic. 112. Shepherd's Purse.

Homoptera — Leaf margin rolled upwards. See No. 410.
APHIS BRASSICAE Linn. 431
Buckton, ii., 34. Houard, No. 2739.

Nematoda — Stem swollen and distorted.
TYLENCHUS DEVASTATRIX Kühn 432
Bd. Agric. Leaflet, No. 46.

Fungi — Swollen white patches on stem, leaves, etc. See No. 394.
CYSTOPUS CANDIDUS Lév. 433
Massee, Textbook of Plant Diseases, p. 59.

Lepidium campestre Br. 86. Common Pepperwort.

Coleoptera — Spherical tumours at base of stem. See No. 439.
CEUTHORRHYNCHUS PLEUROSTIGMA Marsh 434
Houard, No. 2492.

Fungi — White swollen patches on stem, leaves, etc. See No. 394.
CYSTOPUS CANDIDUS Lév. 435
Massee, Textbook of Plant Diseases, p. 59.

Lepidium Draba Linn. Whitlow Pepperwort.

Coleoptera — Nodular swellings of very variable size on the roots and stem, containing several larval cavities.
CEUTHORRHYNCHUS PLEUROSTIGMA Marsh 436
Houard, No. 2491.

Thlaspi arvense Linn. 84. Penny-Cress.

,, — Elongated spindle-like swellings on the stem and branches, containing many cells with a single larva in

each ; sometimes the interior is reduced by the larvae to a single large cavity.

CEUTHORRHYNCHUS CONTRACTUS Marsh 437

Connold, Plant Galls, fig. 241. Houard, No. 2505. This beetle also attacks the stems of *Thlaspi perfoliatum* Linn. in Central Europe.

Coleoptera Rounded swelling on the upper part of the root.

CEUTHORRHYNCHUS PLEUROSTIGMA Marsh 438

Houard, No. 2504. Also attacks *Thlaspi perfoliatum* in Germany.

Cakile maritima Scop. 64. Purple Sea-Rocket.

,, Pea-like swelling in the lower part of the stem, below the cotyledons, resulting from hypertrophy of the bark containing the larval cavity.

CEUTHORRHYNCHUS PLEUROSTIGMA Marsh 439

Houard, No. 2543.

Raphanus Raphanistrum Linn. 111. Wild Radish.

,, Tumours on root. See No. 426.

CEUTHORRHYNCHUS ASSIMILIS Pay. 440

Connold, Plant Galls, p. 202.

,, Fleshy, unilocular pea-like galls on the roots, usually near the stem, sometimes larger and plurilocular, each cavity containing a white larva. M. E.

CEUTHORRHYNCHUS PLEUROSTIGMA Marsh 441

Houard, No. 2629.

,, On the midrib of the leaf, or the petiole, an elongated fusiform swelling with a large axial cavity. Imago, June, I.

CEUTHORRHYNCHUS QUADRIDENS Panzer 442

Houard, No. 2631.

Fungi Swollen white patches on stem, leaves, etc. See No. 394.

CYSTOPUS CANDIDUS Lév. 443

Massee, Textbook of Plant Diseases, p. 59.

Mycetozoa Tumours on the roots. See No. 381.

PLASMODIOPHORA BRASSICA Wor. 444

Massee, Textbook of Plant Diseases, p. 334.

SAXIFRAGACEAE

Chrysosplenium oppositifolium Linn. 107. Golden Saxifrage.

Fungi — Thickened, whitish, and roundish spots on the leaves, containing the hyaline teleutospores. June to September.
ENTYLOMA CHRYSOSPLENII B. and Br. 445
Syn. *Protomyces chrysosplenii* B. and Br.
Plowright, p. 291.

Ribes Grossularia Linn. Gooseberry.

Homoptera — Large reddish or brown blisters on the leaves. The aphides congregate in the concavities on the inferior surface. Aphis shining mottled green, with long antennae and pale green cornicles, the winged viviparous ♀ has a black head and yellow cornicles.
RHOPALOSIPHUM RIBIS Koch 446
Buckton, ii., p. 1. Bd. Agric. Leaflet, No. 68 (revised 1908).

,, — Large reddish-brown or yellow blisters on the leaves, which often curl up, especially on the top shoots. Aphis much resembles the preceding, but the winged viviparous ♀ has an olive head and black cornicles.
MYZUS RIBIS Linn. 447
Houard, No. 2789. Bd. Agric. Leaflet, No. 68 (revised 1908).

Fungi — Fruit and leaves with thickened spots, reddish above and yellow below, containing the yellow aecidiospores.
AECIDIUM GROSSULARIAE Gmelin 448
Plowright, p. 263.

Ribes rubrum Linn. Red Currant.

Homoptera — Leaves blistered. See No. 446.
RHOPALOSIPHUM RIBIS Koch 449
Buckton, ii., p. 1. Bd. Agric. Leaflet, No. 68 (revised 1908).

,, — Apical leaves blistered and contorted. See No. 447.
MYZUS RIBIS Linn. 450
Connold, Plant Galls, p. 101. Houard, No. 2808.

Acari — Buds hypertrophied and deformed. Leaves and flowers are but rarely produced, and such are always atrophied.
ERIOPHYES RIBIS Nalepa 451
Syn. *Phytoptus ribes* Murray.
Connold, Plant Galls, p. 101. Houard, No. 2807.

Ribes nigrum Linn. Black Currant.

Homoptera — Leaves blistered. See No. 446.
RHOPALOSIPHUM RIBIS Koch 452
Bd. Agric. Leaflet, No. 68 (revised 1908).

,, — Apical leaves blistered and deformed. See No. 447.
MYZUS RIBIS Linn. 447.
Connold, Veg. Galls, pl. 106; Plant Galls, fig. 100. 453
Houard, No. 2794.

Acari — Buds hypertrophied. See No. 451.
ERIOPHYES RIBIS Nalepa 454
Connold, Veg. Galls, pl. 62; Plant Galls, fig. 99. Warburton and Embleton, 1902, pls. 33, 34. Houard, No. 2793.

ROSACEAE

Prunus spinosa Linn. 108. Blackthorn.

Hymenoptera — Hard, globular, gregarious or coalescent growths on the subterranean roots. See No. 239.
BIORRHIZA APTERA Bosc. 455
Connold, Plant Galls, pp. 54, 137, 245.

Diptera — Leaf thickened along a nerve, usually the midrib, forming a yellow or reddish glabrous pouch on the inferior surface, with a narrow elongated opening on the superior one. Larvae yellowish-orange. M. E. Imago, spring, II.
PUTONIELLA MARSUPIALIS F. Löw 456
Syn. *Cecidomyia pruni* Kltb.
Connold, Plant Galls, pp. 82, 245. Houard, No. 3295.

Homoptera — Leaf margins crumpled and swollen. Aphis pale green, mottled with dark green, and having a black dorsal stripe; cornicles small, black.
HYALOPTERUS PRUNI Fabr. 457
Buckton, ii., 111. Houard, No. 3289.

,, — Leaf margins crinkled and swollen. Aphis pale green with red eyes, and having one to three green stripes down the back.
PHORODON HUMULI Schank 458
Buckton, i., 167. Houard, No. 3292.

,, — Leaves distorted and swollen. Aphis yellowish-green with three greenish olive stripes, lower abdominal rings stained ochreous.
APHIS PADI Linn. 459
Houard, No. 3290.

BULLACE (*Prunus insititia*). A BRANCH WITH FOUR NORMAL FRUITS, AND THREE THAT ARE GREATLY ENLARGED THROUGH THE PRESENCE OF THE FUNGUS *Exoascus pruni*

Acari Pustules about 4 by 2 mm. on the upper surface of the leaf, green, reddish, or brown, often numerous and coalescent, opening by a minute hairy aperture on the inferior surface. (Plate XXI. 1.)

ERIOPHYES SIMILIS Nalepa 460

Syn. *Phytoptus similis* Nal.

Connold, Veg. Galls, pl. 65; Plant Galls, fig. 68. Houard, No. 3294.

Fungi Densely fasciculated twigs on the branches, forming a "witch's broom."

EXOASCUS DEFORMANS Fückel 461

Syn. *Ascomyces deformans* Berk.

Massee, Brit. Fung. Flora, iv., p. 15.

,, Fruit much swollen and deformed, often curved and flattened, about three times the normal size, without stone or kernel. The whitish bloom, which appears in July on these malformed fruits, is the fruit of the fungus, and consists of closely packed asci.

EXOASCUS PRUNI Fückel 462

Syn. *Ascomyces pruni* B. and Br.

Massee, Brit. Fung. Flora, iv., p. 14.

Prunus insititia Linn. 67. Bullace.

Homoptera Leaf margins swollen. See No. 457.

HYALOPTERUS PRUNI Fabr. 463

Buckton, ii., 111.

Acari Pustules on the leaves. See No. 460.

ERIOPHYES SIMILIS Nalepa 464

Houard, No. 3265.

Fungi Densely fasciated twigs. See No. 461.

EXOASCUS DEFORMANS Fückel 465

,, Fruit deformed. See No. 462 and Plate XXV.

EXOASCUS PRUNI Fckl. 466

Connold, Veg. Galls, pls. 126, 129; Plant Galls, fig. 79.

? Branches swollen, bark destroyed, the margin of the wound surrounded by a thickened irregular mass of living bark, presenting the condition known as "canker."

467

Massee, Textbook of Plant Diseases, p. 127.

At one time said to have been caused by the fungus *Nectria ditissima*, which, however, has been shown to be only a saprophyte. Probably results from the presence of aphides.

Prunus Cerasus Linn. 36. Dwarf Cherry.

? Bark of stem and branches cankered and destroyed in some parts, thickened in others. See No. 467. 468

Connold, Plant Galls, fig. 89.

Prunus Padus Linn. 70. Bird Cherry.

Homoptera Leaves involute, crumpled, and swollen. Aphis yellowish-green, with three greenish-olive stripes; lower abdominal rings stained ochreous red.

APHIS PADI Linn. 469

Buckton, ii., 62. Houard, No. 3313. This aphis attacks various grasses on the Continent, including *Agropyron repens* Beauv., *Holcus mollis* Linn., and *Alopecurus pratensis* Linn.

Acari Minute glossy nail-like projections, 3 to 4 mm. high, on the upper surface of the leaf, gregarious, but not often coalescent, greenish-yellow, red or reddish-brown, opening on the inferior surface. June to September.

ERIOPHYES PADI Nalepa 470

Syn. *Phytoptus padi* Nalepa.
Connold, Plant Galls, fig. 65. Houard, No. 3314.

? Bark cankered and thickened. See No. 467. 471

Massee, Textbook of Plant Diseases, p. 127.

Fungi Fruit swollen and deformed. See No. 462.

EXOASCUS PRUNI Fckl. 472

Massee, Brit. Fung. Flora, iv., p. 15.

,, Densely fasciated twigs on the branches. See No. 461.

EXOASCUS DEFORMANS Fckl. 473

Massee, Brit. Fung. Flora, iv., p. 15.

Spiraea Ulmaria Linn. 112. Meadow Sweet.

Homoptera Leaf margin rolled inwards, bent, and discoloured. Aphis large, shining green, cornicles green or tipped with black.

MACROSIPHUM ULMARIAE Sch. 474

Syn. *Siphonophora pisi* Kalt.
Buckton, i., p. 134. Houard, No. 2833.

Diptera Small hemispherical yellowish or carmine swellings on the upper surface of the leaf, often very numerous; the swellings on the inferior surface are cylindroconic.

Each gall is inhabited by a yellowish larva. June to September. M. G. (Text, Fig. 12.)

PERRISIA ULMARIAE Bremi 475

Syn. *Dasyneura ulmariae* Bremi, *Cecidomyia ulmariae* Bremi.

Connold, Veg. Galls, pl. 89; Plant Galls, fig. 158. Houard, No. 2839.

Spiraea Filipendula Linn. 65. Dropwort.

Diptera Solitary or conglomerated swellings, each forming a hollow truncated cone, in the axils of the leaves, or on the leaf itself, green at first, becoming reddish or purple. The gall is hemispherical on the inferior surface of the leaf, and cylindrical on the superior one, with the opening at the apex of the cone. Each gall contains a yellowish-white larva. M. G. (Text, Fig. 10.)

PERRISIA ULMARIAE Bremi 476

Connold, Plant Galls, fig. 103. Houard, No. 2830.

Rubus idaeus Linn. 111. Raspberry.

Hymenoptera Large elongated swelling on the stem, which is frequently greatly curved. Surface mammillated, each projection denoting the position of an ovoid or circular larval chamber. Reddish or purple when growing, brown at maturity. M. G.

DIASTROPHUS RUBI Hartig 477

Connold, Plant Galls, p. 85. Houard, No. 2963.

Diptera Slightly elongated, but pronounced swelling on the stem; surface rough, bark cracked and fissured longitudinally, reddish-brown. The irregular cavities within contain white larvae. M. G.

LASIOPTERA RUBI Heeger 478

Houard, No. 2964.

,, Leaves distorted, midrib swollen and bent. Larvae white, gregarious. M. E. Spring, II.

PERRISIA PLICATRIX H. Löw 479

Houard, No. 2966.

Homoptera Leaf margins greatly twisted and involute, often to the midrib. Leaf usually discoloured and slightly thickened. Aphis large, shining green, slightly pilose, cornicles curved and slightly thickened at the base. May and June.

NECTAROSIPHUM RUBI Kalt. 480

Syn. *Siphonophora rubi* Kalt.

Buckton, i., 140. Houard, No. 2968.

Rubus plicatus Weike and Nees (*fruticosus* Linn.). 69. Bramble.

Hymen-optera — Elongated swelling on the stem. See No. 477.
DIASTROPHUS RUBI Hartig 481
Connold, Veg. Galls, pl. 40; Plant Galls, fig. 72. Houard, No. 2975.

Diptera — Leaves distorted. Midrib swollen. See No. 479.
PERRISIA PLICATRIX H. Löw 482
Connold, Plant Galls, p. 86. Houard, No. 2978.

,, — Slightly elongated swelling on the stem. See No. 478.
LASIOPTERA RUBI Heeger 483
Connold, Veg. Galls, pl. 117; Plant Galls, fig. 73. Houard, No. 2976.

Acari — Leaves, shoots, and all green parts bearing a silky felt of greyish-white hairs, which are cylindrical and pointed. *Phyllerium rubi* Fries.
ERIOPHYES GIBBOSUS Nalepa 484

Trail, Wild Fauna and Flora of Kew (1906), p. 42. Species of Rubus not stated.

Fungi — Large warty excrescences from the size of a pea to that of a walnut. On shoots of "blackberry." ? *R. Plicatus*.
CONIOTHYRIUM TUMAEFACIENS Güss. 485
Journ. Hort. Soc., xxiv., p. 230 (1908).

,, — Elongated red patches on the stems, which crack in winter. Large rugged outgrowths of callus are formed in the neighbourhood of the cracks. (Plate XXVI.)
CONIOTHYRIUM FÜCKELII Saccardo 486

Rubus rusticanus Merc. 74.

Coleop-tera — Flower bud swollen, remaining closed.
ANTHONOMUS RUBI Herbst. 487
Houard, No. 2992.

Rubus caesius Linn. 78. Dewberry.

Hymen-optera — Greatly elongated swelling on the stem. See No. 477.
DIASTROPHUS RUBI Hartig 488
Connold, Plant Galls, p. 85. Houard, No. 3023.

Diptera — Slightly elongated swelling on the stem. See No. 478.
LASIOPTERA RUBI Heeger 489
Connold, Plant Galls, p. 85. Houard, No. 3024.

BLACKBERRY STEMS *(Rubus plicatus)* WITH GALLS RESULTING FROM THE PRESENCE OF THE FUNGUS *Coniothyrium Fückelii.* THE CONDITION POPULARLY KNOWN AS "CANKER"

Diptera Leaves distorted, midrib swollen. See No. 479.
PERRISIA PLICATRIX H. Löw 490
Houard, No. 3025.

Fragaria vesca Linn. 111. Wild Strawberry.
Nematoda Stem deformed, much swollen, with numerous buds. The abnormal branches are much enlarged, sometimes fasciated, often remaining separated, and the plant then resembles a small cauliflower. Leaves more or less deformed, with one lobe instead of three. The parasites swarm in the tissues. April to September.
APHELENCHUS FRAGARIAE Ritz.-Bos 491
Connold, Plant Galls, fig. 287. Houard, No. 3055.

,, Gall superficially resembling the preceding, but the thickened parts of the stem are white, the leaves are somewhat yellowish, and the roots not so abundant. The eelworms live between the sheaths and the stem.
APHELENCHUS ORMERODIS Ritz.-Bos 492
Houard, No. 3056.

Potentilla erecta Hampe. 112. Common Tormentil.
Hymenoptera Ovoid or spherical swellings on the stem, rarely on a petiole, consisting of a single cell or numerous larval cells which never become fused. Greenish-yellow, reddish or purple.
XESTOPHANES BREVITARSUS Thoms. 493
Syn. *Xestophanes tormentillae* Cam.
Connold, Veg. Galls, pl. 43; Plant Galls, fig. 295. Houard, No. 3064.

Potentilla reptans Linn. 99. Creeping Cinquefoil.
,, Rounded swellings on the stem, sometimes in a bud, singly, about the size of a pea, forming a long fusiform swelling when coalescent; the surface cracks at maturity. Each cavity contains a single larva. M. G. Imago, May or June, II.
XESTOPHANES POTENTILLAE Retz 494
Syn. *Aulax splendens* Hartig.
Connold, Veg. Galls, pls. 13, 14, 129*b*; Plant Galls, 494*a*
fig. 92. Houard, Nos. 3060, 3061.

Potentilla argentea Linn. 57. Hoary Cinquefoil.
,, Rounded or fusiform swelling on the stem, surface usually mammillated; plurilocular.
DIASTROPHUS MAYRI Reinhard 495
Connold. Plant Galls, p. 246.

Poterium Sanguisorba Linn. 74. Lesser Burnet.
Acari All the green parts of the plant and the inflorescence deformed, and covered with a felt of long yellowish or white variously contorted hairs.
ERIOPHYES SANGUISORBAE Can. 496
Syn. *Phytoptus sanguisorbae* Can.
Connold, Veg. Galls, pl. 64; Plant Galls, fig. 81. Houard, No. 3103.

Rosa spinosissima Linn. 94. Burnet-leaved Rose.
Hymenoptera Ovoid or reniform swellings on the stems, leaves, petioles, and flower buds, covered with minute spines and tinted green, purple, or bright red. Often conglomerated, and then attaining considerable dimensions; sometimes 497
fusiform or flattened. Each cell contains a single larva. 498
RHODITES SPINOSISSIMAE Giraud 499
Connold, Veg. Galls, pl. 42; Plant Galls, fig. 259. 499*a*
Houard, No. 3239.

" Glabrous rounded swelling about the size of a pea, attached by a minute stalk to the upper surface of the leaflet, occasionally to a stem or a sepal. It is both solitary and gregarious. Tinted yellowish-green, brown, or red.
RHODITES EGLANTERIAE Hartig 500
Houard, No. 3238.

Rosa mollis Sm. (*R. villosa* Linn.). 71.
" Pea-like swelling on the leaf. See No. 500.
RHODITES EGLANTERIAE Hartig 501
Trail, 1878. Houard, No. 3138.

" On the inflorescence, stems (at the place of a bud) and leaves. A mass of small, rounded, very hard galls, each containing a larva, the whole covered with a shaggy mass of long pinnatifid hairs of a clear green colour, or more or less tinted with red. Dimensions variable. Autumnal.
RHODITES ROSAE Linn. 502
Trail, 1878. Houard, No. 3136. 502*a*
502*b*

Diptera Leaflets folded upwards, the margins meeting and forming a pod, which is often tinted red or brown. Each pod contains numerous yellowish-red larvae. M. E.
PERRISIA ROSARUM Hardy 503
Syn. *Dasyneura rosarum* Hardy; *Cecidomyia rosarum* Hardy.
Hardy, 1850, p. 186. Houard, No. 3135.

Rosa Eglanteria Hudson. 63. Sweet-briar.

Hymenoptera Moss-like growths on leaves, etc. See No. 502.
RHODITES ROSAE Linn. 504
Connold, Veg. Galls, pl. 116; Plant Galls, fig. 288. Houard, No. 3155.

,, On the leaflets gall shape and size of a large pea, glabrous, with a few large spines projecting from it, yellowish-green or white, tinted pink or red. Unilocular and unilarval, often deformed by the presence of parasites.
RHODITES ROSARUM Giraud 505
Syn. *Rhodites nervosus* Cameron.
Houard, No. 3157.

,, Globular swelling on leaflet. See No. 500.
RHODITES EGLANTERIAE Hartig 506
Houard, No. 3158.

Diptera Leaflets folded upwards. See No. 503.
PERRISIA ROSARUM Hardy 507

Rosa canina Linn. 112. Dog Rose.

Hymenoptera Glabrous pea-like swellings on leaflets. See No. 500 and Plate III. 7.
RHODITES EGLANTERIAE Hartig 508
Connold, Veg. Galls, pl. 112; Plant Galls, figs. 260, 261. Houard, No. 3191.

,, Moss-like growths on leaves, etc. See No. 502 and Plate III. 1.
RHODITES ROSAE Linn. 509
Connold, Veg. Galls, pls. 114, 115; Plant Galls, fig. 264. Houard, No. 3187.

,, Globular spiny outgrowths on leaflets. See No. 505 and Plate III. 4.
RHODITES ROSARUM Giraud 510
Connold, Veg. Galls, pl. 113; Plant Galls, fig. 263. Houard, No. 3186.

,, Leaflets folded into rolls of variable intensity, forming a pouch for the greyish-green larvae. Larva with black or brown head. M. E. Imago, spring, II.
BLENNOCAMPA PUSILLA Klug. 511
,, Theobald, Enemies of the Rose, 1910, figs. 3, 4. Houard, No. 3183.

Diptera Leaflets with folded margins. See No. 503.
PERRISIA ROSARUM Hardy 512
Connold, Veg. Galls, pl. 87; Plant Galls, fig. 261. Houard, No. 3186.

Fungi — Stem swollen and cankered. See No. 486.
CONIOTHYRIUM FÜCKELII Saccardo 513
Theobald, Enemies of the Rose, 1910, p. 31.

Rosa arvensis Hudson. 69. Trailing Rose.

Hymenoptera — Glabrous pea-like swellings on the leaflets. See No. 500.
RHODITES EGLANTERIAE Hartig 514
Houard, No. 3117.

,, — Moss-like growths on stem, etc. See No. 502.
RHODITES ROSAE Linn. 515
Houard, No. 3115.

,, — Globular spiny outgrowths on leaflets. See No. 505.
RHODITES ROSARUM Giraud 516
Houard, No. 3116.

Acari — Subspherical swellings with tuberculated surface, seated on the nodes, and attaining the size of a walnut.
ERIOPHYES ROSAE 517
Connold, Plant Galls, fig. 265. Houard, No. 3114, ascribed to an unknown Eriophyid. The name given above is a provisional one.

Pyrus torminalis Ehrh. 50. Wild Service Tree.

Homoptera — Terminal leaves deformed, bunched, and recurved. Aphis small, yellowish-green or reddish-brown.
APHIS SORBI Kalt. 518
Buckton, ii., p. 59. Houard, No. 2901.

Pyrus Aria Ehrh. 50. White Beam Tree.

Acari — Pustules slightly elevated above the surface on both sides of the leaf, glabrous, frequently coalescent. Greenish-yellow at first, ultimately brown, opening on the inferior surface.
ERIOPHYES PYRI Pagenst 519
Syn. *Phytoptus pyri* Murray.
Connold, Plant Galls, fig. 44. Houard, No. 2902.

Pyrus Aucuparia Ehrh. 108. Mountain Ash.

Homoptera — Terminal leaves deformed. See No. 518.
APHIS SORBI Kalt. 520
Buckton, ii., p. 59. Houard, No. 2908.

Acari — Pustules on the leaves. See No. 519.
ERIOPHYES PYRI Pagenst 521
Houard, No. 2912.

Acari Lenticular chocolate-coloured pustules on the leaves, gregarious, often coalescent.

ERIOPHYES PYRI Pagenst, var. VARIOLATA Nal. 522

Connold, Veg. Galls, pls. 46, 76*b*; Plant Galls, fig. 36. Houard, No. 2913.

,, On the leaf blade, usually on the inferior surface, a tuft of short, blunt, cylindrical or club-shaped hairs, whitish at first, becoming rusty brown. *Erineum sorbeum* Persoon.

ERIOPHYES sp. 523

Greville, 1827, v., pl. 263. Houard, No. 2911.

Pyrus communis Linn. 49. Pear Tree.

Hymenoptera Brilliant translucent pustules, usually solitary, showing equally on both surfaces of the leaf.

MICRONEMATUS ABBREVIATUS Hartig 524

Syn. *Nematus abbreviatus* Htg.

Houard, No. 2872.

Diptera Young fruit abnormally swollen, with numerous larvae within. May to July. M. E.

CONTARINIA PYRIVORA Ridley 525

Syn. *Diplosis pyrivora* Ridley.

Connold, Veg. Galls, pl. 123; Plant Galls, fig. 240. Houard, No. 2855.

,, Leaf margin rolled upwards and thickened, green or yellowish.

PERRISIA PYRI Bouché 526

Syn. *Dasyneura pyri* Bouché.

Houard, No. 2864.

Homoptera Leaves rolled towards the base, margins shrivelled and crumpled.

PSYLLA PYRISUGA Först. 527

Houard, No. 2867.

Acari Pustules on the leaves. See No. 519.

ERIOPHYES PYRI Pagenst 528

Connold, Veg. Galls, pl. 59; Plant Galls, figs. 239, 348. Houard, No. 2871.

,, Tufts of hairs, at first yellowish or reddish, becoming rusty brown, forming a felt occurring in patches on both surfaces of the leaf, but usually on the inferior one. *Erineum pyrinum* Persoon.

ERIOPHYES sp. 529

Greville, 1823, i., pl. 22. Houard, No. 2873.

Fungi Thickened yellow spots on the branches, leaves, and fruit, containing the pale brown aecidiospores. June to August. Teleutospores on *Juniperus communis*.
GYMNOSPORANGIUM CLAVARIAEFORME Jacq. 530
Plowright, p. 233.

Pyrus Malus Linn. 89. Crab Apple.

Coleoptera Bud swollen, remaining closed.
ANTHONOMUS POMORUM Linn. 531
Houard, No. 2881.

,, Leaf bud not expanded, transformed into a mass of abnormally folded little leaves, the external ones making a kind of hood surrounding a tough case composed of decaying leaves stuck together.
ANTHONOMUS ROSINAE Des Gozis 532
Houard, No. 2945.

Diptera Leaf margins recurved, forming compact, glossy, swollen rolls, which are often tinted with yellow, red, or purple.
PERRISIA MALI Kieffer 533
Connold, Plant Galls, fig. 31. Houard, No. 2885.

Homoptera Leaf curled near the petiole, which is deformed and shrivelled. Aphis dark slaty grey mottled with green. Larvae powdered with white meal, numerous.
APHIS POMI De Geer 534
Syn. *Aphis mali* Fabr.
Buckton, ii., 46.

,, Irregular protuberances on roots, stems, and branches, at first soft, then woody. Surface rough. Aphis dark shining brown, with a sparse cottony coat. (Plate XI.)
MYZOXYLUS LANIGER Hausm. 535
Syn. *Schizoneura lanigera* Hausm. 536
Connold, Veg. Galls, pl. 35; Plant Galls, fig. 28. Buckton, iii., 90. Houard, Nos. 2882, 2883.

,, Leaves yellow or red, with incurvature and rolling of the margins. Aphis almost sooty black, hairy, with two strong spines on the prothorax.
APHIS PYRI Fonsc. 537
Syn. *Aphis crataegi* Kalt.
Connold, Plant Galls, fig. 29. Buckton, ii., 97. Houard, No. 2898.

Acari A mass of blunt hairs usually on the inferior surface of the leaf, forming a felt-like covering, reddish-white at first, becoming brownish. *Erineum malinum* D. G.
ERIOPHYES MALINUS Nalepa 538
Houard, No. 2892.

Crataegus monogyna Jacq. III. Common Hawthorn.

Coleoptera Ovary feebly swollen.

ANTHONOMUS POMORUM Linn. 539

Houard, No. 2939.

Diptera Terminal leaves deformed, forming a rosette, their surfaces covered with little green or reddish tubercles. Petiole and lower part of midrib swollen. Larvae gregarious, reddish. M. E. Imago, spring, II.

PERRISIA CRATAEGI Winn. 540

Syn. *Cecidomyia crataegi* Winn.

Connold, Veg. Galls, pl. 79; Plant Galls, fig. 128. Houard, No. 2942.

Homoptera Little red swelling on the leaf.

PSYLLA CRATAEGI Schrank 541

Houard, No. 2951.

,, Leaves of the young shoots blistered and rolled, forming tangled masses of a reddish-brown colour. May to July. Aphis bright green, slightly mealy; cornicles dark at the tips.

APHIS CRATAEGI Buckton 542

Buckton, ii., p. 35. Connold, Plant Galls, fig. 127.

Acari Small lenticular pustules on the upper surface of the leaf, with a small opening on the inferior one. Gregarious, often coalescent, orange, brown, or purple.

ERIOPHYES CRATAEGI Can. 543

Syn. *Phytoptus crataegi* Can.

Connold, Veg. Galls, pl. 50; Plant Galls, fig. 129. Houard, No. 2950.

,, Margins of the leaf tightly rolled inwards, colour normal. Interior of the roll lined with short club-shaped brown hairs. *Erineum clandestinum* Greville. *Erineum oxyacanthae* Persoon.

ERIOPHYES GONIOTHORAX Nalepa 544

Syn. *Phytoptus goniothorax* Nalepa.

Connold, Veg. Galls, pls. 53, 76*a*; Plant Galls, fig. 130. Houard, No. 2948.

Fungi Thickish blisters of irregular shape on the leaves, green at first, then dark brown, and frosted with the spores. The leaves do not curl.

TAPHRINA BULLATA Tulasne 545

Syn. *Exoascus bullatus* Fckl. *Ascomyces bullatus* Berk.

Massee, Brit. Fung. Flora, iv, p. 15.

Fungi Thickened yellow spots on the stems, leaves, and fruit, containing the pale brown aecidiospores. Teleutospores on *Juniperus communis*.

GYMNOSPORANGIUM CLAVARIAEFORME Jacq. 546

Syn. *Roestelia lacerata* Tulasne.

Plowright, p. 233. Connold, Plant Galls, fig. 126.

LEGUMINOSAE

Genista anglica Linn. 86. Needle Whin.

Diptera Terminal leaves tufted, swollen, forming a yellowish hairy mass about the size of a hazel nut. Sometimes the flowers and buds are also thickened and distorted. Larvae gregarious, white at first, then pale rose colour. July and August. M. E.

PERRISIA GENISTICOLA F. Löw 547

Houard, No. 3349. 547*a*

547*b*

Genista tinctoria Linn. 76. Dyer's Green Weed.

Terminal leaves and flowers swollen. See No. 547.

PERRISIA GENISTICOLA F. Löw 548

Connold, Plant Galls, fig. 120. Swanton, Knowledge, 549
June, 1910. Houard, Nos. 3368, 3369.

Internodes at the extremity of the twig shortened and much thickened, forming globular fleshy galls about 8 to 10 mm. in diameter; the lateral shoots are also often atrophied and deformed. Plurilocular. Larvae yellowish-white, movements jerky. M. E. Imago, April, II.

CONTARINIA MELANOCERA Kieffer 550

Houard, No. 3372.

Ulex europaeus Linn. 112. Common Gorse.

Coleoptera Young stems with rounded or ovoid swellings about the size of a large pea, longitudinally striated. Unilocular, with a single larva. M. G. Spring, II. (Text, Fig. 6.)

APION SCUTELLARE Kirby 551

Connold, Plant Galls, fig. 116. Swanton, Knowledge, June, 1910. Houard, No. 3399.

Diptera Bud swollen, forming a green, fleshy, ovoid or conical gall, about 5 mm. high by 3 mm. in diameter, with a large internal cavity.

ASPHONDYLIA ULICIS Verrall 552

Verrall, 1875, p. 224 Trail, 1873, p. 172. Connold, Plant Galls, p. 245.

? Elongated swelling, 50 to 70 mm. long, at the apex of the stem, deeply furrowed longitudinally, 24 to 30 mm. in circumference. There is occasionally much curvature. Leaves shortened, swollen at the base, and crowded.

553

Connold, Plant Galls, fig. 115. The cause of the swelling was unknown to Connold. I have not observed it, and it is not mentioned in Houard's "Zoocécidies des Plantes d'Europe."

Ulex nanus Roth. (*minor* Forster). 27. Lesser Gorse.

Coleoptera Pea-like swelling on stem. See No. 551.

APION SCUTELLARE Kirby 554

Houard, No. 3403.

Cytisus scoparius Link. 109. Common Broom.

" Elongated ovoid swelling on the stem, 40 to 60 mm. long, about 5 mm. in diameter, containing numerous larval cavities just beneath the bark.

APION IMMUNE, Kirby 555

Houard, No. 3428.

Diptera Axillary buds deformed, swollen and fleshy, ovoid, sessile or definitely stalked, 5 to 12 mm. long. The inflorescence is sometimes attacked, the buds remain closed, and are slightly swollen. Unilocular and unilarval. Larva greenish; it does not leap. May to October.

ASPHONDYLIA SARATHAMNI H. Löw 556

Connold, Plant Galls, fig. 75. Houard, Nos. 3414, 557
3422.

" Pod deformed, having at its basal end a swelling about the size of a pea. Rarely two galls are present on a pod. Each gall contains a single orange-coloured larva. June to August. M. G.

ASPHONDYLIA MAYERI Liebel 558

Connold, Plant Galls, fig. 76. Binnie, Proc. Glasgow Nat. Hist. Soc., 1877, p. 112. Houard, No. 3412.

" In an axillary bud. A smooth tube-like gall, 5 to 10 mm. long, 2 mm. in diameter, or less. Apex with four or five teeth curving outwards, or two teeth bending inwards. The aperture is always provided with numerous shining hairs directed upwards. Larva red. M. E.

PERRISIA TUBICOLA Kieffer 559

Houard, No. 3423.

Homoptera Discoloured, unilateral, oblong, or subspherical masses on the subterranean part of the stem. Solitary or coalescent. The e tumours proceed from an expansion of the parenchyma through the bark, and have no internal cavity. Their surface is smooth at first, becoming fissured. Aphis black.

APHIS LABURNI Kalt. 560

Houard, No. 3376. Buckton records this aphis from laburnum pods in July and August, but does not allude to a gall.

Medicago sativa Linn. Lucerne.

Diptera Soft, hairy, ovoid, yellowish-green swelling, consisting of a deformed shoot surrounded by two swollen stipules, opening at its summit at maturity. Larvae gregarious. M. E.

PERRISIA IGNORATA Wachtl. 561

Syn. *Dasyneura ignorata* Wachtl. *Cecidomyia medicaginis* Bremi.

Connold, Plant Galls, p. 245. Houard, No. 3515.

Medicago falcata Linn. 5. Yellow Medick.

" Flowers and seed pod swollen, reddish. Larvae gregarious. M. E.

CONTARINIA LOTI De Geer 562

Syn. *Diplosis loti* De Geer.

Connold, Plant Galls, p. 245.

Melilotus altissima Thiull. (*officinalis* Lam.). 73. Common Melilot.

Coleoptera Flowers remarkably green, larva living in the interior of the stem and near the apex.

APION MELILOTI Kirby 563

Houard, No. 3543.

Trifolium pratense Linn. 112. Purple Clover.

" Floral axis thickened ; calyx swollen, containing a larva.

APION ASSIMILE Kirby 564

Ormerod, Manual, p. 55. Houard, No. 3580.

" Excrescences on the roots, each containing a larva.

APION VARIPES Germar 565

Houard, No. 3587.

" Flowers transformed into a tubercular hard mass. Larva within a cavity in the floral axis.

APION APRICANS Herbst 566

Ormerod, Manual, p. 55. Houard, No. 3581.

Coleoptera — Flowers greenish, larva living in a long gallery in the stem.

HYLASTINUS OBSCURUS Marsh 567

Houard, No. 3582.

Diptera — Leaflets folded upwards in the form of a pod, swollen, reddish or yellowish. Larvae pale reddish-yellow, gregarious. Leaflets sometimes folded inwards. M. G.

PERRISIA TRIFOLII F. Löw 568

Syn. *Dasyneura trifolii* F. Löw. *Cecidomyia trifolii* F. Löw. 569

Connold, Plant Galls, p. 244. Houard, Nos. 3589, 3591.

Nematoda — Development of the plant arrested, internodes shortened and thickened; leaves deformed, with margins rolled inwards.

TYLENCHUS DEVASTATRIX Kühn 570

Connold, Plant Galls, p. 244. Houard, No. 3584.

Fungi — Elongated swellings and distortions of the petioles; the sori containing the brown uredospores burst through the epidermis.

UROMYCES TRIFOLII Alb. and Schw. 571

Syn. *Trichobasis fallens* Cooke.

Plowright, p. 124.

Trifolium medium Linn. 108. Zigzag Clover.

Diptera — Leaflets swollen, pod-like. See No. 568.

PERRISIA TRIFOLII F. Löw 572

Houard, No. 3596.

Trifolium ochroleucon Huds. 11. Sulphur-coloured Trefoil.

Coleoptera — Floral axis thickened; calyx swollen, containing a larva.

APION ASSIMILE Kirby 573

Houard, No. 3599.

„ — Flowers deformed.

APION TRIFOLII Linn. 574

Houard, No. 3560.

Trifolium repens Linn. 112. White or Dutch Clover.

„ — Oval swelling on the stem.

APION LAEVICOLLE Kirby 575

Houard, No. 3563.

„ — Flowers greenish, larva in a long gallery in the stem.

HYLASTINUS OBSCURUS Marsh 576

Houard, No. 3562.

Diptera Leaflet swollen and pod-like. See No. 568.
PERRISIA TRIFOLII F. Löw 577
Connold, Plant Galls, fig. 93. Houard, No. 3564.

Nematoda Arrested development, with deformity. See No. 570.
TYLENCHUS DEVASTATRIX Kühn 578
Connold, Plant Galls, p. 244.

Fungi Petioles distorted. See No. 571.
UROMYCES TRIFOLII Alb. and Schw. 579
Plowright, p. 124.

Trifolium procumbens Linn. 105. Hop Trefoil.

Coleoptera Fusiform swelling 6 mm. long, 2·5 mm. in diameter; at the apex of the stem, containing a single larva. M. G.
APION PUBESCENS Kirby 580
Houard, No. 3554.

Trifolium dubium Sibth. (*minus* Sm.). 109. Lesser Yellow Trefoil.

" Fusiform swelling on the stem. See No. 580.
APION PUBESCENS Kirby 581
Houard, No. 3546.

Anthyllis Vulneraria Linn. 105. Kidney Vetch.

Diptera Flowers not expanding, swollen; the various organs are thickened and fleshy. Larvae orange-coloured.
CECIDOMYID sp. 582
Trail, 1878. Houard, No. 3604.

Lotus corniculatus Linn. 112. Common Bird's-foot Trefoil.

" Flowers swollen and distorted, usually somewhat hairy, reddish-brown. The galls are terminal, conical, sometimes as many as eight in a cluster. The terminal leaves are rolled, thickened, and distorted. Occasionally the axillary buds are deformed. Larvae gregarious. M. E. (Text, Fig. 1.)
CONTARINIA LOTI De Geer 583
Syn. *Diplosis loti* De Geer.
Connold, Plant Galls, figs. 296, 297. Houard, No. 3614.

Lotus uliginosus Schkuhr. 100. Marsh Bird's-foot Trefoil.

"Bud galls formed of an atrophied bud surrounded by stipules and stunted leaves, all somewhat thickened."
PERRISIA LOTICOLA Rübs. 584
Trail, Scot. Nat., I., 1891, p. 124. Wild Fauna of Kew Gardens, 1906, p. 42.

Astragalus danicus Retz. 43. Milk Vetch.
Diptera Leaflets folded upwards into a kind of pod.
PERRISIA ONOBRYCHIDIS Bremi 585
Syn. *Dasyneura onobrychidis* Bremi. *Cecidomyia Giraudi* Fr.
Trail, 1873, p. 78. Fitch, 1880*b*, p. 151. Connold, Plant Galls, p. 244.
Houard, No. 3646.

Onobrychis viciaefolia Scop. 30. Sainfoin.
,, Leaflets folded upwards into a kind of a pod.
PERRISIA ONOBRYCHIDIS Bremi 586
Connold, Plant Galls, p. 246. Houard, No. 3690.

Vicia hirsuta Gray. 109. Hairy Tare.
Coleoptera On the stem, either floral or leaf stalk. An unilocular thin-walled swelling, attaining twice the normal thickness of the attacked part.
APION GYLLENHALI Kirby 587
Trail, 1885. Houard, No. 3752.

Vicia Cracca Linn. 112. Tufted Vetch.
,, Stem swollen. See No. 587.
APION GYLLENHALI Kirby 588
Connold, Plant Galls, p. 246. Trail, 1878. Houard, No. 3722.

Diptera Flower deformed, calyx twice the normal size, petals enlarged and swollen at the base, filaments of the stamens swollen and very thick, anthers atrophied. Ovary short and swollen. Style remaining rudimentary. Larvae gregarious, yellowish-orange leaping. M. E.
CONTARINIA CRACCAE Kieffer 589
Houard, No. 3721.

Vicia sylvatica Linn. 80. Wood Vetch.
,, Leaflets forming a pod, hypertrophy very pronounced.
PERRISIA VICIAE Kieffer 590
Trail, 1873. Houard, No. 2731.

,, Leaflets folded upwards, with slight hypertrophy, forming a pod. Larvae white.
CECIDOMYIA sp. 591
Trail, 1878. Houard, No. 3730.

Vicia sepium Linn. 112. Bush Vetch.
Coleoptera Stem swollen. See No. 587.
APION GYLLENHALI Kirby 592
Trail, 1890. Houard, No. 3695.

Diptera Flowers deformed. See No. 589.

CONTARINIA CRACCAE Kieffer 593

Connold, Veg. Galls, pl. 122; Plant Galls, fig. 302, attributed therein to *Contarinia loti* De Geer. Houard, No. 3693.

" Margins of the leaflets rolled back, swollen, forming a hard pod. Sometimes many leaves are attacked. July to October. Larvae gregarious, white. M. G. Imago, spring, II.

PERRISIA VICIAE Kieffer 594

Trail, Scot. Nat., II., 1873, p. 78; Trans. N. H. Soc. Aberdeen, 1878, p. 59.

Connold, Plant Galls, fig. 301, attributed therein to *Contarinia loti* De Geer. Houard, No. 3696.

" Leaflets with revolute margins which meet to form a pod; the midrib, which is often much swollen, forms the keel of the pod. Larvae gregarious, usually five to seven in a leaflet, reddish. M. E.

PERRISIA LATHYRICOLA Rübs. 595

Syn. *Cecidomyia lathyri* Frfld.

Connold, Veg. Galls, pl. 80; figs. 237, 238. Houard, No. 3771.

Lathyrus montanus Bernh. 107. Tuberous Bitter Vetch.

Hymenoptera Woody swelling on the rhizome, 10 mm. long, and 12 to 14 mm. in maximum diameter.

AULAX sp. 596

Cameron, 1893, p. 205, pl. ix. 4. Houard, No. 3780.

EUPHORBIACEAE

Diptera **Euphorbia Esula** Linn. Leafy-branched Spurge.

Terminal leaves deformed, much enlarged, forming a lax globose gall containing numerous orange-red larvae. M. G.

PERRISIA CAPITIGENA Bremi 597

Syn. *Dasyneura capitigena* Bremi. *Cecidomyia euphorbiae*, Löw.

Connold, Plant Galls, p. 246.

Mercurialis perennis Linn. 107. Dog's Mercury.

Coleoptera More or less elongated ovoid swellings on the stem, 598
branches, flower stalks, and occasionally on the petioles. 599

APION SEMIVITTATUM Gyllh. 599*a*

Houard, No. 3867. 599*b*

Mercurialis annua Linn. 42. Annual Mercury.

" Stem swollen. See No. 599.

APION SEMIVITTATUM Gyllh. 600

Houard, No. 3865.

BUXACEAE

Buxus sempervirens Linn. 3. Box.

Diptera Pustules in the parenchyma of the leaf, which is slightly thickened and somewhat yellowish. Larvae yellow. M. G.

MONARTHROPALPUS BUXI Laboulb. 601

Syn. *Diplosis buxi* Lab.

Connold, Plant Galls, p. 82. Houard, No. 3911.

Homoptera The leaves at the extremity of a branch deformed and bent into a hemispherical gall resembling a cabbage in miniature. Greyish or light brown.

PSYLLA BUXI Linn. 602

Connold, Plant Galls, fig. 69. Houard, No. 3908.

ACERACEAE

Acer Pseudo-platanus Linn. Sycamore.

Acari Brilliantly coloured pimples (1 to 2 mm. in diameter), carmine, purple or brown, on the upper surface of the leaf; often very numerous The internal cavity is lined with unicellular brown hairs which are particularly numerous at the opening on the inferior surface. *Ceratoneon vulgare* Bremi. (Plate XIII. 1.)

ERIOPHYES MACRORRHYNCHUS Nalepa 603

Syn. *Phytoptus aceris* Nalepa. *Phytoptus myriadeum* Murray.

Connold, Veg. Galls, pl. 73; Plant Galls, fig. 290, therein attributed to *Phyllocoptes acericola*, Nal. Houard, No. 3978.

,, Isolated glabrous pimples on the upper surface of the leaf, 2 to 4 mm. in diameter. Internal cavity lined with brown pluricellular hairs, opening inferior. *Cephaloneon solitarium* Bremi.

ERIOPHYES MACROCHELUS Nalepa 604

Syn. *Phytoptus macrochelus* Nalepa.

Connold, Plant Galls, fig. 289. Swanton, Knowledge, June, 1910. Houard, No. 3979.

,, Slight swelling on the upper surface of the leaf at the junction of the nervures; the depression on the corresponding inferior surface is clothed with a mass of swollen hairs. (Plate XIII. 15.)

PHYLLOCOPTES ACERICOLA Nalepa 605

Houard, No. 3975.

Acer campestre Linn. 62. Maple.

Diptera Elongated fusiform swelling on the petiole; occasionally the basal part of the midrib is also involved. Reddish-

brown or purple. Usually contains a single white larva. M. E. July to October.

ATRICHOSEMA ACERIS Kieffer 606 607

A Müller, 1869, p. 21. Connold, Plant Galls, fig. 153. Swanton, Knowledge, June, 1910. Houard, No. 4030.

Acari Scattered pustules on upper surface of the leaf. See No. 604 and Plate XIII. 11.

ERIOPHYES MACROCHELUS Nalepa 608

Connold, Veg. Galls, pl. 56; Plant Galls, fig. 151. Houard, No. 4017.

,, Numerous minute pustules on the upper surface of the leaf. See No. 603 and Plate XIII. 7.

ERIOPHYES MACRORRHYNCHUS Nalepa 609

Connold, Veg. Galls, pl. 57; Plant Galls, fig. 152. Houard, No. 4016.

RHAMNACEAE

Rhamnus catharticus Linn. 58. Buckthorn.

Homoptera Leaf margins rolled upwards, much thickened and twisted, often brightly coloured, red or purplish-brown.

TRICHOPSYLLA WALKERI Förster 610

Connold, Plant Galls, fig. 77. Houard, No. 4069.

,, Little shallow depressions on the lower margin of the leaf.

TRIOZA RHAMNI Schrank 611

Houard, No. 4068.

Fungi Leaves and peduncles greatly distorted, often with very large bright yellow swellings. Spores orange-yellow. May and June.

Aecidial stage of PUCCINIA CORONIFERA Kleb. 612

Syn. *Aecidium crassum* Persoon.

Plowright, p. 163.

Rhamnus Frangula Linn. 66. Alder Buckthorn.

Homoptera Leaf margins rolled upwards. See No. 610.

TRICHOPSYLLA WALKERI Förster 613

Houard, No. 4077.

Fungi Leaves and peduncles swollen and distorted. With orange-coloured swellings. May and June.

Aecidial stage of PUCCINIA CORONATA Corda 614

Plowright, p. 163.

TILIACEAE

Tilia platyphyllos Scop. 3. Broad-leaved Lime.

Diptera Globular growths instead of flowers, flower stalks and branches swollen, with rounded or elongated tumours upon them, 2 to 10 mm. in diameter, reddish or green. Larvae solitary or gregarious, sulphur-yellow. M. E. Imago, August, I., or spring, II. 615

CONTARINIA TILIARUM Kieffer 616

Syn. *Cecidomyia tiliae* Sch., *Cecidomyia tilicola* Rud. 617

Connold, Veg. Galls, pl. 30. Houard, Nos. 4122, 4123, 4125.

Tilia vulgaris Hayne (*europaea* Linn.). Common Lime.

,, Leaf margin rolled upwards and thickened, leathery, tinted greenish-yellow or dark red. Usually the distortion is limited to the margin near the petiole, sometimes, however, the whole of one side is involved. Larvae gregarious, reddish-yellow. M. E. Imago, II.

PERRISIA TILIAMVOLVENS Rübs. 618

Houard, No. 4160.

,, Flower stalk swollen. See No. 616 and Plate VIII. 7.

CONTARINIA TILIARUM Kieffer 619

Connold, Veg. Galls, pl. 121; Plant Galls, fig. 150. Houard, No. 4154.

Acari Margins of the bracts more or less swollen and curled, often sickle-shaped, slightly pubescent. Yellowish-green, suffused with red. July to September.

ERIOPHYES TILIARIUS Con. 620

Syn. *Phytoptus tiliarius* Murray.

Connold, Veg. Galls, pl. 69; Plant Galls, fig. 149. Houard, No. 4132. ?

,, Leaf margin more or less rolled upwards, the interior of the roll is very hairy; sometimes reddish-brown without.

ERIOPHYES TETRATRICHUS Nalepa 621

Syn. *Phytoptus tetratrichus* Nalepa.

Connold, Veg. Galls, pl. 67; Plant Galls, fig. 147. Houard, No. 4159.

,, Glabrous, tubular projections, about 8 mm. high, on the upper surface of the leaf, often very numerous; yellowish-green, reddish, or purple-brown. Hairy within, the open-

ing on the inferior surface is surrounded by hairs. The well-known "nail" gall. (Text, Fig. 22.)

ERIOPHYES TILIAE Pagenst 622

Connold, Veg. Galls, pl. 68; Plant Galls, fig. 148. Houard, No. 4162.

MALVACEAE

Malva sylvestris Linn. 91. Common Mallow.

Homoptera — Leaves more or less crinkled, the margins turned downwards. Sometimes the flower buds are also deformed. Aphis yellow or pale green, head brown or reddish between the antennae. 623

APHIS MALVAE Koch 624

Buckton, ii., 42. Houard, No. 4182.

HYPERICACEAE

Hypericum perforatum Linn. 101. Common St. John's Wort.

Diptera — Apical leaves swollen, carinated at the base and tinted with red. The white larvae live between them. M. E.

PERRISIA SEROTINA Winn. 625

Syn. *Cecidomyia serotina* Wtz.

According to Kieffer (Ann. Soc. Ent. France, 1901, p. 341), the galls described by Trail (Scot. Nat., II., 1873, p. 31) as caused by this species are those of *P. hyperici* Bremi.

Houard, No. 4211.

" — Apical leaves bunched together, slightly deformed, but neither incurved nor carinated. Larvae red. M. G.

PERRISIA HYPERICI Bremi 626

Syn. *Cecidomyia hyperici* Bremi.

Trail, Scot. Nat., II., 1873, p. 31. Houard, No. 4212.

Hypericum humifusum Linn. 100. Trailing St. John's Wort.

" — Apical leaves swollen. See No. 625.

PERRISIA SEROTINA Winn. 627

Connold, Plant Galls, p. 245. Houard, No. 4196.

" — Apical leaves bunched together. See No. 626.

PERRISIA HYPERICI Bremi 628

Connold, Plant Galls, p. 245.

Hypericum pulchrum Linn. 111. Small St. John's Wort.

Apical leaves swollen. See No. 625.

PERRISIA SEROTINA Winn. 629

Houard, No. 4203.

Diptera Apical leaves bunched together. See. No. 626.
PERRISIA HYPERICI Bremi 630
Trail, Scot. Nat., II., 1873, p. 31. Houard, No. 4204.

CISTACEAE

Helianthemum Chamaecistus Mill. 92. Common Rock Rose.

,, Gall terminal, ovoid, consisting of a rosette of deformed leaves. M. G.
CONTARINIA HELIANTHEMI Hardy 631
Syn. *Diplosis helianthemi* Hardy.
Hardy, 1850, p. 187. Connold, Plant Galls, p. 246. Houard, No. 4269.

VIOLACEAE

Viola odorata Linn. 80. Sweet Violet.

,, Terminal leaves clustered, their edges revolute, slightly thickened. The revolute margins often meet. The affected parts are smooth, and streaked with red or brown. Larvae gregarious, white at first, tinted with orange at the extremities, or entirely pale orange. M. G.
PERRISIA AFFINIS Kieffer 632
Syn. *Dasyneura affinis* Kieffer.
Trail, Scot. Nat., I., 1873, p. 124. Houard, No. 4281.

,, Swellings on stems and midribs containing the black spore mass. May to September.
UROCYSTIS VIOLAE Sow. 633
Plowright, p. 288.

Viola sylvestris Kit. 55. Lilac Hedge Violet.

,, Leaf margins revolute. See No. 632.
PERRISIA AFFINIS Kieffer 634
Trail, Scot. Nat., I., 1873. Houard, Nos. 4283, 4284. 635

Fungi Stems and midribs swollen. See No. 633.
UROCYSTIS VIOLAE Sow. 636
Plowright, p. 288.

Viola canina Linn. 88. Dog Violet.

Diptera Terminal leaves revolute. See No. 632.
PERRISIA AFFINIS Kieff. 637
Trail, Scot. Nat., I., 1873. Connold, Veg. Galls, pl. 92; and Plant Galls, fig. 305, in both attributed to *Cecidomyia* (*Perrisia*) *violae*. Houard, No. 4290.

Fungi — Stems and midribs swollen. See No. 633.
UROCYSTIS VIOLAE Sow. 638
Connold, Veg. Galls, p. 100; Plant Galls, fig. 304.

Viola arvensis Murr. 112. Wild Pansy.
Diptera — Ovary swollen, transformed into a gall.
LAUXANIA AENEA Meigen 639
Houard, No. 4296.

,, — Tufts of leaves at the extremity of the stem, with abnormal pilosity. Larvae gregarious, pale orange-red.
PERRISIA VIOLAE F. Löw 640
Syn. *Cecidomyia violae* F. Löw, *Dasyneura violae* Kieffer.
Houard, No. 4293.

ONAGRACEAE

Epilobium angustifolium Linn. 96. Rose-bay Willow-herb.
Diptera — Buds swollen, ovoid not opening. Calyx slightly modified, the other floral organs shortened, the petals deformed, brown. Larvae gregarious, colour of chamois leather. M. E. 641
PERRISIA EPILOBII F. Löw 642
Houard, No. 4345.

Homoptera — Margin of the leaf rolled upwards.
APHALARA NEBULOSA Zett. 643
Scott, 1881, p. 275; 1882*b*, p. 42, 43. Houard, No. 4349.

Epilobium hirsutum Linn. 96. Great Hairy Willow-herb.
Lepidoptera — Elongated swelling on the stem containing a white larva. M. G. The white cocoon is left sticking out of the gall after the moth has emerged.
MOMPHA DECORELLA Stephenson 644
Syn. *Laverna decorella* Ste.

? — Protuberances of irregular form on the side of the seed capsule. Small, seldom more than three together.
645
Connold, Plant Galls, fig. 325.

Epilobium parviflorum Schreb. 103. Small flowered Willow herb.
Lepidoptera — Swelling on the stem. See No. 644 and Plate VII. 6.
MOMPHA DECORELLA Steph. 646
Barrett, 1865, p. 197. Houard, No. 4334.

Epilobium montanum Linn. 112. Broad, smooth-leaved Willow-herb.

Lepidoptera — Swelling on the stem. See No. 644.
MOMPHA DECORELLA Steph. 647
Connold, Plant Galls, p. 106. Houard, No. 4335.

Homoptera — Terminal leaves contorted, midrib shortened. Sometimes the entire summit of the plant is deformed. Aphis dull black powdered with white meal.
APHIS EPILOBII Kalt. 648
Buckton, II., p. 71. Houard, No. 4336.

Epilobium palustre Linn. 110. Narrow-leaved Willow herb.

Lepidoptera — Elongated swelling on the stem. See No. 644.
MOMPHA DECORELLA Steph. 649
Barret, 1865, p. 197. Houard, No. 4344.

ARALIACEAE

Hedera Helix Linn. 122. Common Ivy.

Homoptera — Margin of the leaf crinkled and swollen.
ASPIODOTUS HEDERAE Sign. 650
Houard, No. 4366.

,, — Margins of the leaves on the young shoots rolled inwards. Aphis dull brown with black tarsi. June.
APHIS HEDERAE Kalt. 651
Buckton II., p. 75. Houard, No. 4365.

UMBELLIFERAE

Sanicula europaea Linn. 109. Wood Sanicle.

Fungi — Purple thickened spots on the stems and leaves containing the yellow aecidiospores.
Aecidial stage of PUCCINIA SANICULAE Grev. 652
Syn. *Aecidium saniculae* Carm.
Plowright, p. 160.

Apium graveolens Linn. 58. Wild Celery.

, — Conspicuous elongated swellings on the stems, containing the orange-yellow aecidiospores. Appearing in May.
PUCCINIA APII Wallr. 653
Plowright, p. 156.

Apium nodiflorum Reichb. fil. 82. Procumbent Marshwort.

Fungi — Conspicuous indurated swellings on the stems and petioles. At first translucent, pale yellow, then white, at length brownish. May to October.

PROTOMYCES MACROSPORUS Unger 654

Plowright, p. 300.

Aegopodium Podagraria Linn. 100. Goutweed.

" — Stems and midribs much swollen and distorted by the presence of the mycelium.

PUCCINIA AEGOPODII Schum. 655

Plowright, p. 202.

" — Elongated swelling on the stem. See No. 654.

PROTOMYCES MACROSPORUS Unger 656

Plowright, p. 300.

Pimpinella Saxifraga Linn. 102. Burnet Saxifrage.

Diptera — Seed swollen, much enlarged and rounded, diameter 3 to 5 mm., containing an orange larva. M. E.

SCHIZOMYIA PIMPINELLAE F. Löw 657

Syn. *Asphondylia pimpinellae* F. Löw.

Connold, Plant Galls, p. 215. Houard, No. 4445.

" — Flowers swollen, globular, not opening, more or less tinted with red. Larva solitary, bright brimstone yellow, leaping. M. E. II.

CONTARINIA TRAILI Kieffer 658

Houard, No. 4446. According to Kieffer this is the dipteron which inhabits the galls described by Binnie in Proc. Glasgow N. H. Soc., 1877, p. 185.

Acari — Leaflets deformed, club-like, pale green, becoming red or purple. Rachis seldom galled. June to August.

ERIOPHYES PIMPINELLAE Con. 659

Connold, Plant Galls, fig. 275.

Conopodium majus Loret (*Bunium denudatum*, D. C.). 109. Common Earth-nut.

Fungi — Swellings on the stems, containing the orange-yellow aecidiospores. Somewhat rare in Britain.

AECIDIUM BUNII D. C. 660

Plowright, p. 270.

Anthriscus sylvestris Hoffm. 107. Wild Chervil.

Homoptera — Turgidity of the margin causes a swelling on the inferior surface of the leaf. The margin is bent inwards.

TRIOZA VIRIDULA Zett. 661

Houard, No. 4391.

HEMLOCK WATER DROPWORT *(Oenanthe crocata)* WITH GALLS CAUSED BY THE FUNGUS *Protomyces macrosporus*

Fungi Elongated swellings on the stems. See No. 654.
PROTOMYCES MACROSPORUS Unger 662
Plowright, p. 300.

Oenanthe crocata Linn. 92. Hemlock Water Dropwort.
,, Indurated swellings on the stems. See No. 654 and Plate XXVII.
PROTOMYCES MACROSPORUS Unger 663
Plowright, p. 300. Connold, Plant Galls, fig. 135.

Angelica sylvestris Linn. 112. Wild Angelica.
Diptera Flower swollen, remaining closed.
CECIDOMYIA sp. 664
Binnie, 1877. Houard, No. 4475.

Fungi Indurated swellings on the stems. See No. 654.
PROTOMYCES MACROSPORUS Unger 665
Plowright, p. 300.

Peucedanum sativum Benth. and Hook. fil. 58. Parsnip.
Diptera Seeds and flower stalks deformed. See No. 657.
SCHIZOMYIA PIMPINELLAE F. Löw 666
Connold, Plant Galls, p. 91. Houard, No. 4499.

Heracleum Sphondylium Linn. 112. Hogweed.
,, Leaves folded, thickened at the parts where the white gregarious larvae occur. M. E.
MACROLABIS CORRUGANS F. Löw 667
Syn. *Cecidomyia corrugans* F. Löw.
Houard, No. 4512.

,, Yellow pustules, usually near the leaf stalk, each containing a white, leaping larva. If the galls are numerous, the leaf becomes bent and folded at its margins. M. E.
CONTARINIA HERACLEI Rübs. 668
Syn. *Cecidomyia heraclei* Kalt.
Connold, Plant Galls, p. 245. Houard, No. 4513.

Fungi Indurated swellings on the stems and petioles. See No. 654.
PROTOMYCES MACROSPORUS Unger 669
Plowright, p. 300.

Daucus Carota Linn. 109. Wild Carrot.
Diptera Floral axis, peduncles and seeds swollen and deformed. The swollen seeds are often raised above the inflorescence

and are either violet or brown. Sometimes there is atrophy, and the seed loses the normal longitudinal ridges and points. Larvae yellowish. M. E.

SCHIZOMYIA PIMPINELLAE F. Löw 670

Syn. *Asphondylia pimpinellae* F. Löw.

Connold, Veg. Galls, pl. 119; Plant Galls, fig. 84. Houard, No. 4529.

Homoptera The segments of the leaf margins bent inwards and turgid, giving rise to a slight swelling on the upper surface.

TRIOZA VIRIDULA Zett. 671

Houard, No. 4536.

CORNACEAE

Cornus sanguinea Linn. 67. Dogwood.

Diptera Galls in the form of a truncated cone developed chiefly on the under side of the leaf. The cone is divided into two or three lobes at the apex which is on the inferior surface. Pale green, becoming purple or reddish. Larvae orange-yellow. M. E. Imago, spring, II. (Plate IX. 7.)

OLIGOTROPHUS CORNI Giraud 672

Syn. *Hormomyia corni* Giraud.

Connold, Plant Galls, fig. 102. Houard, No. 4543.

ERICACEAE

Calluna vulgaris Hull. 112. Ling.

Homoptera A small tuft of little abnormal branches grouped together above a slightly swollen part of the stem.

MYTILASPIS POMORUM Bouché 673

Douglas, 1888, p. 16. Houard, No. 4575.

Acari Numerous densely fasciated abnormal branches forming a miniature "witch's broom." The leaves are wrinkled and covered with whitish hairs.

ERIOPHYES CALLUNAE 674

Houard, No. 4574 (without specific name). The above is a provisional name.

Vaccinium Vitis-Idaea Linn. 67. Cowberry.

Hymenoptera Galls bean-like, appearing on both sides of the leaf; the walls of the larval cavity are at first thick, but become very thin by the time the larva is full fed. Dull green at first, then brownish. These galls much resemble those of *Pontania salicis.*

PONTANIA VACCINIELLA Cameron 675

Syn. *Nematus vacciniellus* Cameron.

Cameron, 1876, p. 190. Connold, Plant Galls, p. 100. Houard, No. 4573.

Diptera On the stem. A gall composed of hypertrophied imbricated leaves, reddish below, glabrous and shining, with a central cavity containing a yellow larva.

CECIDOMYIA sp. 676

Trail, 1878, 1885. Houard, No. 4571.

Vaccinium Myrtillus Linn. 101. Whortleberry.

Fungi Red or purplish swollen spots on the leaves, which are variously deformed; also elongated fusiform swellings on the stems.

EXOBASIDIUM VACCINII Wor. 677

Connold, Plant Galls, fig. 96. Massee, Brit. Fung. Flora, i., 108. 677*a*

OLEACEAE

Fraxinus excelsior Linn. 109. Common Ash.

Diptera Circular pustules, 6 to 8 mm. in diameter in the leaf parenchyma, not very pronounced; tinted green or yellowish-green, with an irregularly rounded opening on the inferior surface. The gall falls away at maturity, leaving a hole with a brown border in the leaf.

DASYNEURA FRAXINEA Kieffer 678

Trail, 1886, p. 108; 1888, p. 24. Houard, No. 4647.

,, On a petiole, or more frequently on the midrib, of a leaflet. Elongated pouch-like galls, opening by a slit on the upper surface in September. Tinted with reddish-brown or purple. Larvae orange-coloured, gregarious. M. E. 679

PERRISIA FRAXINI Kieffer 680

Connold, Veg. Galls, pl. 93; Plant Galls, fig. 33; as caused by *Diplosis botularia* Wtz., which is, however, only an inquiline. Houard, No. 4644.

,, Leaflets thickened and hardened, their margins folded upwards until they form a pouch for the numerous white larvae. M. E.

PERRISIA ACROPHILA Winn. 681

Syn. *Dasyneura acrophila* Winn.

Connold, Plant Galls, p. 244. Houard, No. 4643.

Homoptera Leaf thickened, loosely rolled inwards, greenish-yellow, tinted, and streaked with red and purple. Usually the blade on one side of the midrib only is affected; rarely both margins are rolled. (Plate XII. 1.)

PSYLLOPSIS FRAXINI Linn. 682

Connold, Veg. Galls, pl. 74; Plant Galls, fig. 34, as caused by *Phyllocoptes fraxini* Nalepa. Houard, No. 4641.

Acari — Flowers and fruit greatly swollen and deformed, forming conglomerations resembling a cauliflower; they are soft and yellowish at first, becoming brown and hard at maturity.

ERIOPHYES FRAXINI Karp. 683

Syn. *Phytoptus fraxini* Nalepa.

Masters, 1869, p. 421, fig. 202. Connold, Plant Galls, fig. 35. *Diplosis fraxinella* Meade is an inquiline. Houard, No. 4636.

,, — Leaf margin very tightly rolled inwards, the interior covered with abnormal hairs. Colour green or yellowish.

PHYLLOCOPTES FRAXINI Nalepa 684

Houard, No. 4642.

Connold (Veg. Galls, pl. 74; Plant Galls, fig. 34) delineates galls which he ascribes to this mite, but which, judging from his description, are the *young* state of the galls caused by the psyllid *Psyllopsis fraxini*. He makes no allusion to the hairs; the purple streaks are very characteristic of the psyllid galls.

? — Branches swollen, then fissured. A thickened irregular margin of living bark forms around the wound, giving rise to the familiar cankered appearance.

685

Connold, Plant Galls, fig. 32. Massee, Textbook of Plant Diseases, p. 127. At one time attributed to *Nectria ditissima*, but probably results from the presence of aphides.

Ligustrum vulgare Linn. 83. Common Privet.

Homoptera — Margins of the upper leaves rolled inwards and discoloured; the entire leaf is sometimes bent and twisted. Aphis bright yellow or greenish, with long cornicles tipped with black.

RHOPALOSIPHUM LIGUSTRI Kalt. 686

Buckton, ii., 13. Houard, No. 4682.

GENTIANACEAE

Menyanthes trifoliata Linn. 110. Buckbean.

Fungi — Thickened purplish patches on the leaves, more or less round, sometimes confluent; spores brownish.

PROTOMYCES MENYANTHIS De Bary 687

Plowright, p. 301.

SMALL BINDWEED (*Convolvulus arvensis*) WITH LEAVES SWOLLEN AND DISTORTED AT THE MID-RIB THROUGH THE PRESENCE OF MITES, *Eriophyes convolvuli*

CONVOLVULACEAE

Convolvulus arvensis Linn. 96. Small Bindweed.

Acari Midrib of the leaf, the petiole, and sometimes the lateral veins, swollen, forming a pouch opening on the superior surface. The hypertrophied part is wrinkled, pinkish-red, and completely covered with a velvety pile of short hyaline hairs on both surfaces. June and July. (Plate XXVIII.)

ERIOPHYES CONVOLVULI Nal. 688

Swanton, Knowledge, June, 1910. Houard, No. 4714.

BORAGINACEAE

Lithospermum officinale Linn. 78. Common Gromwell.

Homoptera Terminal leaves more or less bent towards the stem, forming a distorted mass. Aphis reddish-brown, with a large black dorsal spot. Larvae green, with similar dark spot.

APHIS CARDUI Linn. 689

Houard, No. 4742.

LABIATAE

Mentha rotundifolia Huds. 54. Round-leaved Mint.

Fungi Stem much swollen; aecidiospores pale yellowish. May to October.

Aecidial stage of PUCCINIA MENTHAE Persoon 690

Syn. *Aecidium menthae* D. C.
Plowright, p. 157.

Mentha longifolia Huds. (*sylvestris* Linn.). 64. Horse-mint.

" Stem swollen. See No. 690.

PUCCINIA MENTHAE Persoon 691

Plowright, p. 157.

Mentha spicata Linn. (*viridis* Linn.). Spear Mint.

" Stem swollen. See No. 690.

PUCCINIA MENTHAE Persoon 692

Plowright, p. 157.

Mentha aquatica Linn. 112. Water Mint.

" Stem swollen. See No. 690.

PUCCINIA MENTHAE Persoon 693

Plowright, p. 157.

Mentha arvensis Linn. 111. Corn Mint.

Coleoptera — Unilocular swelling on the stem, ovoid or spherical, 4 to 6 mm. long, 2 to 3 mm. in diameter; red, situated just above the upper nodes; the walls are at first thick and fleshy, becoming thin and hard at maturity. The cavity contains a citron-yellow larva. M. G.

APION VICINIUM Kirby 694

Houard, No. 4953.

Fungi — Stem swollen. See No. 690.

PUCCINIA MENTHAE Persoon 695

Plowright, p. 157.

Origanum vulgare Linn. 90. Common Marjoram.

Acari — Inflorescence deformed, the whole forming a mass of white hairs, amongst which the mites creep.

ERIOPHYES ORIGANI Nalepa 696

Connold, Plant Galls, fig. 154. Houard, No. 4901.

Thymus Serphyllum Linn. 112. Wild Thyme.

Homoptera — Ovoid red swellings on the young shoots, not abnormally hairy. Elongated abnormally pubescent red swellings 3 to 4 mm. long, 1 to 2 mm. thick, on the stems. The epidermis of the swelling does not crack. The internal cavity contains a yellowish larva. M. G. 697

APION ATOMARIUM Kirby 698

Houard, Nos. 4918, 4922.

Diptera — Corolla completely altered, transformed into an ovoid body with a large cavity, stamens and pistil absent. Calyx much enlarged, twice the normal size, always exceeding the corolla. The cavity contains a single red larva.

ASPHONDYLIA THYMI Kieffer 699

Trail, Scot. Nat., ii., 1873, p. 252. Houard, No. 4913.

Acari — Flower head and terminal leaves deformed, the leaves elongated and swollen; the whole covered with an abundant white pilosity resembling cotton wool. May to October. 700

ERIOPHYES THOMASI Nalepa 701

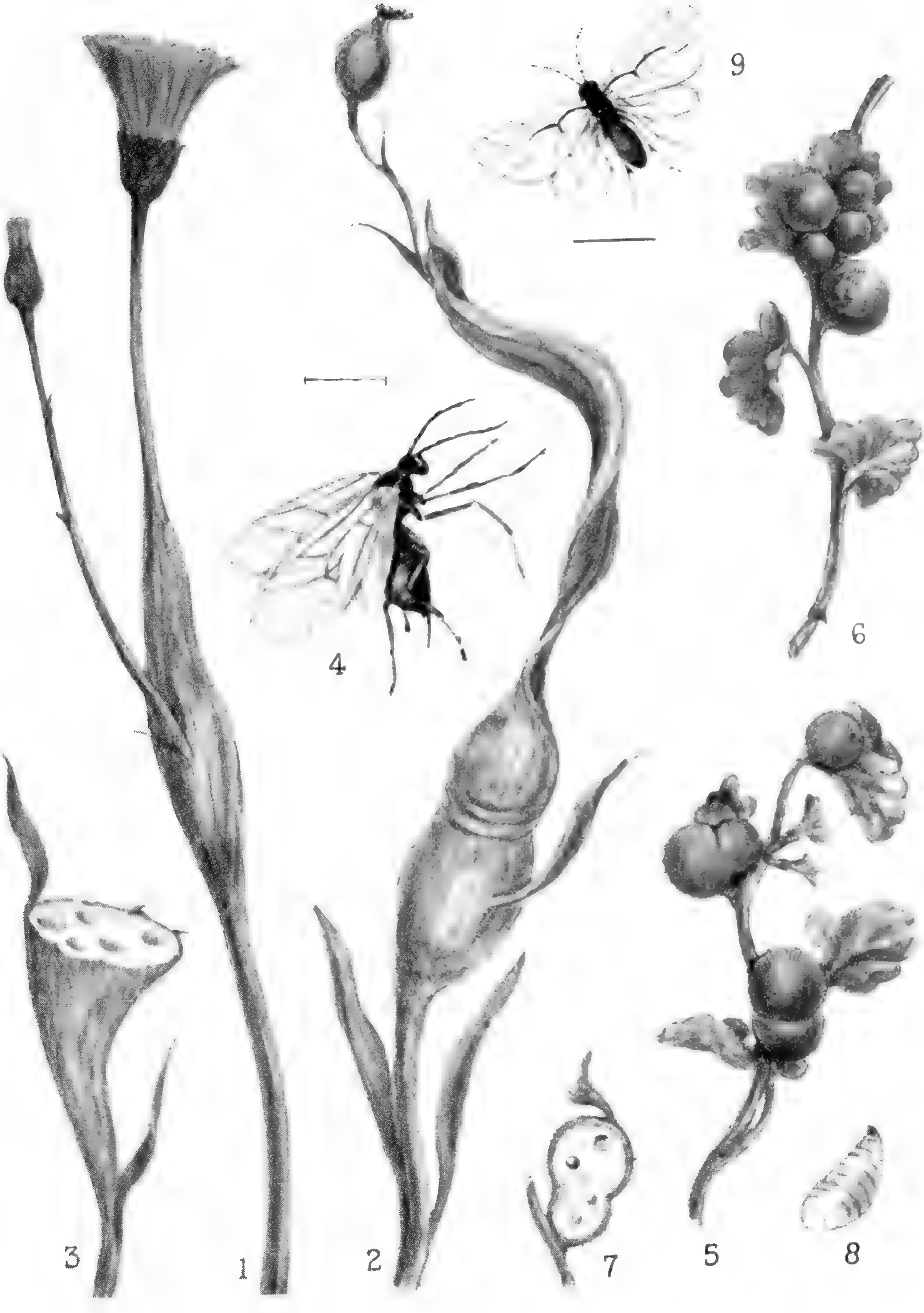
Connold, Plant Galls, fig. 293. Houard, No. 4920.

Calamintha Acinos Clairv. (*arvensis* Lam.). 75. Basil Thyme.

Coleoptera — Ovoid swelling on the stem. See No. 694.

APION VICINIUM Kirby 702

Houard, No. 4896.



GALLS CAUSED BY GALL WASPS ON LONG-ROOTED CAT'S-EAR AND GROUND-IVY

Nepeta Cataria Linn. 59. Cat-mint.

Coleoptera A multilocular elongated swelling with dented surface, sometimes 30 mm. long, on the stem.

APION VICINIUM Kirby 703

Houard, No. 4801.

Nepeta hederacea Trev. (*Glechoma*, Benth.). 103. Ground Ivy.

Hymenoptera Globular fleshy swellings on the leaves (rarely on the stem), varying in size from that of a pea to a marble; pubescent, usually solitary; yellowish-green, becoming suffused with red or purple. Unilocular or plurilocular, each cell containing a single larva. The cells are fleshy at first, very hard at maturity. M. G. Imago, April, II. (Plate XXIX. 5, 6.) 704

AULAX GLECHOMAE Linn. 705

Connold, Veg. Galls, pls. 75, 109; Plant Galls, fig. 122. Houard, No. 4811.

Diptera Cylindrical hairy outgrowths on the upper surface of the leaf, about 4 mm. high; green at first, then reddish or purplish; brown at maturity, falling away and leaving a circular hole in the leaf. Solitary or gregarious, each containing a white larva. M. E. (Text, Fig. 16.)

OLIGOTROPHUS BURSARIUS Bremi 706

Syn. *Cecidomyia bursaria* Bremi.

Connold, Veg. Galls, pl. 78; Plant Galls, fig. 121. Houard, No. 4809.

" Flowers swollen, remaining closed. Two uppermost leaves thickened and reddish at the base, folded upwards so that their margins meet to form a kind of pouch for the gregarious white larvae. M. E. Imago, June, I.

PERRISIA GLECHOMAE Kieffer 707

Houard, Nos. 4807, 4808. 708

Fungi Elongated swellings on the stems, petioles, and nervures. Sori yellowish, teleutospores chestnut-brown. June to October. 709

PUCCINIA GLECHOMATIS D. C. 710

Plowright, p. 214.

Stachys sylvatica Linn. 112. Hedge Woundwort.

Diptera Inflorescence and terminal leaves swollen and deformed. Calyx swollen with enlarged sepals; stamens and ovaries atrophied. Leaves covered with grey hairs. Larvae gregarious, yellowish-orange. M. E. 711

PERRISIA STACHYDIS Bremi 712

Syn. *Cecidomyia stachydis* Bremi. 713

Connold, Plant Galls, figs. 284, 285. Houard, Nos. 4860, 4861, 4862. 714

Galeopsis Tetrahit Linn. 112. Common Hemp-nettle.

Homoptera Terminal leaves tufted, with incurved margins. Aphis greenish-white with bright red eyes, cornicles long, sub-cylindrical. The aphides cluster beneath the leaves.

PHORODON GALEOPSIDIS Kalt. 715

Buckton, i., p. 172. Houard, No. 4832.

Lamium Galeobdolon Crantz. 67. Yellow Archangel.

Diptera Rounded or oval gall on the young shoots about the size of a pea, formed of two leaves with margins in juxta-position. The pouch is covered with a felt of white hair. Larvae white. M. G.

PERRISIA GALEOBDOLONTIS Winn. 716

Syn. *Dasyneura galeobdolontis* Winn.

Mosley, British Galls, Nat. Journ., Jan., 1899, p. 208. Houard, No. 4847.

Ajuga reptans Linn. 109. Creeping Bugle.

Acari Terminal leaves bunched and covered with whitish felt. Margins of radical leaves folded upwards (slightly), and usually on one side only, accompanied by excessive pilosity of the superior surface of the afflicted parts of the leaf; occasionally the felt spreads to other parts of the leaf and the petiole. The hairs are yellowish white, cylin-drical, four or five celled. Attacked leaves are often red or purplish.

ERIOPHYES AJUGAE Nalepa 717

Syn. *Phytoptus ajugae* Nalepa. 718

Connold, Veg. Galls, pls. 45, 118; Plant Galls, fig. 78. Houard, Nos. 4759, 4761.

Fungi Stems greatly swollen. See No. 690.

PUCCINIA MENTHAE Persoon 719

Plowright, p. 158.

SCROPHULARIACEAE

Linaria vulgaris Mill. 99. Yellow Toad-flax.

Hymenoptera Longitudinal or rounded swellings on the roots and stem, greenish and pubescent at first, becoming glabrous and brown. June to August. Larvae yellow. M. G.

AULACIDEA HIERACII Bouché 720

Syn. *Aulax hieracii* Sch.

Connold, Plant Galls, p. 114. Houard, No. 5035.

Coleoptera Yellowish fleshy swellings about the size of a pea, at the junction of root and stem, or on the radical root. Unilocular. M. E.

MECINUS COLLINUS Gyllh. 721

Syn. *Gymnetron collinus* Gyllh.
Connold, Plant Galls, p. 246. Houard, No. 5031.

,, Pea-like gall at the apex of the root just below the ground. Unilocular. M. E.

MECINUS LINARIAE Panzer 722

Houard, No. 5030.

,, Capsule swollen.

MECINUS NOCTIS Herbst. 723

Houard, No. 5025.

Diptera Terminal buds not opening: the leaves are drawn together in a tuft, deformed, enlarged and thickened at the base, forming an ovoid gall about 5 mm. in diameter. Larvae whitish, gregarious. M. E.

CONTARINIA LINARIAE Winn. 724

Syn. *Diplosis linariae* Winn.
Connold, Plant Galls, p. 246. Houard, No. 5028.

Scrophularia nodosa Linn. 109. Knotted Figwort.

Coleoptera Seed case swollen.

MECINUS BECCABUNGAE Linn. 725

Syn. *Gymnetron beccabungae* Linn.
Mosley, Brit. Galls, Nat. Journ., March, 1898, p. 56.

Diptera Flowers deformed, remaining closed and globular, greenish or reddish-brown. Larvae gregarious, white or yellowish; they occur in little depressions on the surface of the hypertrophied pistil, or on the stamens. M. E.

STICTODIPLOSIS SCROPHULARIAE Kieff. 726

Connold, Plant Galls, fig. 111. Houard, No. 5063.

Veronica serphyllifolia Linn. 112. Thyme-leaved Speedwell.

,, Terminal leaves clustered and thickened, forming a rosette, greenish, brown or purple. Larvae gregarious.

CECIDOMYIA sp. 727

Connold, Plant Galls, fig. 283. Houard, No. 5107.

Veronica Chamaedrys Linn. 111. Germander Speedwell.

,, The terminal leaves, covered with a felt of white hairs, have their margins more or less united with the under

surface outwards, forming a pouch containing the orange-yellow larvae. M. G. (Plate VIII. 1.)

PERRISIA VERONICAE Vallot 728

Syn. *Dasyneura veronicae* Vallot.

Connold, Veg. Galls, pl. 91; Plant Galls, fig. 281. Houard, No. 5080.

Acari Leaf margin slightly rolled, hairy; or with a slight depression on the inferior surface covered with a felt of white hairs. The leaves do not approach at their margins to form a pouch.

ERIOPHYES ANCEPS Nalepa 729

Connold, Plant Galls, fig. 286. Houard, No. 5082.

Mycetozoa Stems, petioles, and leaves swollen and stunted, bearing tumours of variable size up to 12 mm. in diameter. If a tumour involves one side of a stem the latter is usually bent or curled. (Plate XVI. 1.)

SOROSPHAERA VERONICA Schröter 730

Blomfield and Schwartz, Annals of Botany, vol. xxiv., No. 93, January, 1910.

Connold, Plant Galls, fig. 280.

Veronica scutellata Linn. 107. Marsh Speedwell.

Coleoptera Flower enlarged through the swelling of the ovary.

MECINUS BECCABUNGAE Linn. 731

Houard, No. 5092.

Veronica Anagallis-aquatica Linn. 100. Water-Speedwell.

,, Ovary swollen.

MECINUS VILLOSULUS Gyllh. 732

Syn. *Gymnetron villosulus* Gyllh.

Connold, Plant Galls, p. 246. Houard, No. 5097.

Veronica Beccabunga Linn. 112. Brooklime.

,, Ovary swollen.

MECINUS BECCABUNGAE Linn. 733

A. Müller, 1876, p. 19. Connold, Plant Galls, p. 86. Houard, No. 5099.

Bartsia Odontites Huds. 111. Red Bartsia.

Nematoda Elongated fusiform swelling on the stem, which becomes bent and distorted. Flowers sometimes drawn together.

TYLENCHUS sp. 734

Connold, Plant Galls, fig. 43. Houard, No. 5125.

Pedicularis sylvatica Linn. 112. Red Rattle.

Acari Leaf margin incurved, tinted with red, covered on the inferior surface with a felt of simple, more or less filiform hairs intermingled with some star-like hairs.

PHYLLOCOPTES PEDICULARIS Nal. 735

Trail, 1885. Houard, No. 5133.

Rhinanthus Crista-galli Linn. 112. Common Yellow Rattle.

Fungi Elongated blackish gouty swellings on the basal part of the stem, or on the root, appearing in autumn.

EPHELINA RADICALIS Massee 736

Syn. *Ephelis rhinanthi* Phil.

Massee, Brit. Fung. Flora, iv., p. 75.

PLANTAGINACEAE

Plantago major Linn. 112. Greater Plantain.

Homoptera Leaf margins crinkled and folded. Aphis bright green, body pilose and slightly tufted with bristles.

APHIS MYOSOTIDIS Koch 737

Houard, No. 5163.

Plantago media Linn. 82. Hoary Plantain.

Coleoptera Elongated swelling on the floral axis, with a cavity containing a blackish larva. (Plate VI. 2.)

MECINUS PYRASTER Herbst. 738

Mosley, Brit. Galls, Nat. Journ., March, 1898, p. 56.

Plantago lanceolata Linn. 112. Ribwort Plantain.

" On the floral axis, rarely on the petiole. An elongated swelling about 8 mm. long, containing a blackish larva. M. G.

MECINUS PYRASTER Herbst. 739

Connold, Plant Galls, p. 197. Houard, No. 5151.

Lepidoptera Flower spike swollen and bent, often branching, containing about six larvae, which pupate therein. May to June.

TORTRIX PALEANA Herb. 740

Connold, Plant Galls, fig. 244.

Nematoda Stem swollen and distorted.

TYLENCHUS DEVASTATRIX Kühn 741

Bd. Agric. Leaflet, No. 46.

Plantago maritima Linn. 78. Seaside Plantain.

Coleoptera Elongated swelling on the floral axis, unilocular, containing a blackish larva. M. G.

MECINUS COLLARIS Germar 742

Connold, Plant Galls, p. 245.

Nematoda Irregularly elongated swellings on the leaves, 2 to 10 mm. long, of a paler tint than the surrounding normal tissue. These galls also appear on the petiole and the flower stalk.

TYLENCHUS sp. 743

Trail, 1885. Houard, No. 5149.

RUBIACEAE

Galium boreale Linn. 43. Cross-leaved Bedstraw.

Diptera On the stem above a node. An ovoid or spherical swelling, with thin walls. The single cavity contains a solitary larva.

CECIDOMYIA sp. 744

Trail, 1878, p. 63. Houard, No. 5196.

Galium cruciata Scop. 97. Crosswort.

Fungi Considerable swellings and distortions in the stems caused by the presence of the mycelium. Aecidiospores orange-yellow; uredospores round or oval, pale brown; teleutospores elliptical, brown.

PUCCINIA GALII Persoon 745

Syn. *Aecidium galii* Persoon, *Trichobasis galii* Lév.

Plowright, pp. 143, 144.

Galium verum Linn. 112. Yellow Bedstraw.

Diptera Flower not opening, thickened, ovoid; reproductive organs atropied or entirely absent. The gall usually contains a single yellow larva. M. E. I., II.

SCHIZOMYIA GALIORUM Kieffer 746

Binnie, 1876, p. 154. Houard, No. 5281.

,, Stems and flower stalks deformed and swollen. Galls solitary or gregarious and coalescent, glossy, rounded, about 8 mm. in diameter; green at first, then reddish-brown. Larvae yellow. M. E. (Text, Fig. 14.)

PERRISIA GALII H. Löw 747

Syn. *Cecidomyia galii* Wtz. 748

Connold, Veg. Galls, pl. 25; Plant Galls, fig. 46. Houard, Nos. 5284, 5292.

Homoptera — A terminal gall consisting of a rounded mass of enlarged and incurved leaves.

TRIOZA GALII Förster 749

Hardy, 1853, p. 3876. Houard, No. 5291.

Acari — Inflorescence and terminal leaves swollen and deformed. Gall ovoid or fusiform, yellowish-green or brownish, hairy, terminating in a small point. Often attains the size of a pea. Interior surface with greenish projections.

ERIOPHYES GALIOBIUS Can. 750

Syn. *Phytoptus galiobus* Can. 751

Connold, Veg. Galls, pl. 52; Plant Galls, fig. 47. Houard, No. 5283.

" — Stems swollen and distorted. See No. 745.

PUCCINIA GALII Persoon 752

Plowright, p. 144.

Galium Mollugo Linn. 77. Great Hedge Bedstraw.

Diptera — Terminal leaves, also those at the nodes, swollen and bunched, greenish or reddish-brown. Larvae gregarious, orange-yellow. M. E.

PERRISIA GALIICOLA F. Löw 753

Syn. *Dasyneura galiicola* F. Löw.

Trail, Scot. Nat., i., 1871, p. 156. Connold, Plant Galls, fig. 117. Houard, No. 5209.

Homoptera — Terminal rounded mass of enlarged and incurved leaves of a pale tint.

TRIOZA GALII Förster 754

Houard, No. 5210.

Fungi — Stems swollen and distorted. See No. 745.

PUCCINIA GALII Persoon 755

Plowright, p. 144.

Galium saxatile Linn. 111. Smooth Heath Bedstraw.

Diptera — Inflorescence deformed. See No. 746.

SCHIZOMYIA GALIORUM Kieffer 756

Trail, Trans. N. H. Soc. Aberdeen, 1878, p. 55. Houard, No. 5248.

Acari — Inflorescence swollen and pubescent. See No. 750.

ERIOPHYES GALIOBIUS Can. 757.

Trail, 1878. Houard, No. 5250.

Galium palustre Linn. 112. Water Bedstraw.

Diptera — A terminal gall, about the size of a hemp seed, consisting of grouped and thickened leaves.

PERRISIA sp. 758

Trail, 1878. Houard, No. 5277.

Homoptera Terminal leaves forming a rounded mass. See No. 754.
TRIOZA GALII Förster 759
Scott, 1882*a*, p. 15. Houard, No. 5276.

Fungi Stems swollen and distorted. See No. 745.
PUCCINIA GALII Persoon 760
Plowright, p. 144.

Galium uliginosum Linn. 93. Rough Water Bedstraw.

Homoptera Terminal leaves forming a rounded mass. See No. 754.
TRIOZA GALII Förster 761
Douglas, 1878, p. 92. Houard, No. 5271.

Fungi Stems swollen and distorted. See No. 745.
PUCCINIA GALII Persoon 762
Plowright, p. 144.

Galium Aparine Linn. 112. Goose-grass.

Diptera Gall terminal, resembling a pineapple, the size of a pea or a blackberry, consisting of undeveloped leaves much hypertrophied below, covered with abnormal hairs, yellowish-green or brownish. Larvae pale sulphur-yellow, gregarious. M. E.
PERRISIA APARINES Kieffer 763
Syn. *Dasyneura aparines* Kieff.
Trail, Scot. Nat., 1878, p. 63. Connold, Plant Galls, fig. 119. Houard, No. 5303.

,, Shoots deformed. Branches, leaves, flowers, and fruits agglomerated and atrophied, with numerous cavities, each containing a single larva.
CECIDOMYIA sp. 764
Trail, 1878. Houard, No. 5304.

Homoptera Terminal leaves forming a rounded mass. See No. 754.
TRIOZA GALII Förster 765
Hardy, 1853, p. 3876. Houard, No. 5306.

Acari Leaf margins rolled either upwards or downwards, contorted, often sickle-shaped. Yellowish-green, then brownish.
ERIOPHYES GALII Karp. 766
Syn. *Phytoptus galii* Karp.
Connold, Veg. Galls, pl. 51; Plant Galls, fig. 118. Houard, No. 5308.

Fungi Stem swollen and distorted. See No. 745.
PUCCINIA GALII Persoon 767
Plowright, p. 144.

Asperula odorata Linn. 106. Woodruff.
Fungi
Stems swollen and distorted. See No. 745.
PUCCINIA GALII Persoon 768
Plowright, p. 144.

Sherardia arvensis Linn. 109. Field Madder.
Homoptera
Terminal leaves forming a rounded mass. See No. 754.
TRIOZA GALII Förster 769
Houard, No. 5172.

CAPRIFOLIACEAE

Adoxa Moschatellina Linn. 91. Moschatel.
Fungi
Stems swollen, the hypertrophied parts, also the leaves, bearing the black sori containing the brown teleutospores. March to May.
PUCCINIA ADOXAE D. C. 770
Plowright, p. 207.

Sambucus nigra Linn. 109. Common Elder.
Acari
Leaf margins rolled upwards, forming a pouch.
EPITRIMERUS TRILOBUS Nalepa 771
Trail, Fauna of Kew Gardens, 1906, p. 43. Houard, No. 5333.

Viburnum Opulus Linn. 102. Guelder Rose.
Homoptera
Leaves at the extremity of a shoot tufted and deformed, red or brown. Aphis black, with pale greenish antennae, and hairy, pale green legs, excepting the femora and tarsi, which are black.
APHIS VIBURNI Scop. 772
Buckton, ii., 77. Houard, No. 5340.

Acari
Green or reddish minute pustules, often very numerous and coalescent, on the upper surface of the leaf, covered with stiff hairs. The opening is on the inferior surface, and is surrounded by a mass of hairs: *Cephaloneon pubescens* Bremi.
ERIOPHYES VIBURNI Nalepa 773
Syn. *Phytoptus viburni* Nal.
Connold, Veg. Galls, pl. 71 ; Plant Galls, fig. 123.

Viburnum Lantana Linn. 45. Mealy Guelder Rose.
Diptera
Lenticular pustules of parenchyma on the leaves, about 5 mm. in diameter, often numerous ; tinted red or purple above ; yellowish or white below, very slightly raised and

covered with minute hairs. Larva yellowish. M. E. (Plate XXX.)

OLIGOTROPHUS SOLMSII Kieffer 774

Connold, Plant Galls, fig. 310 (without name). Swanton, Knowledge, June, 1910. Houard, No. 5349.

Homoptera Terminal leaves of a shoot deformed. See No. 772.

APHIS VIBURNI Scop. 775

Buckton, ii., 77. Houard, No. 5345.

Acari Pustules on the upper surface of the leaf. See No. 772 and Plate XXI. 5.

ERIOPHYES VIBURNI Nal. 776

Connold, Plant Galls, fig. 309. Houard, No. 5350.

Lonicera Caprifolium Linn. Perfoliate Honeysuckle.

Lepidoptera Flowers swollen, remaining closed. M. E.

ORNEODES HEXADACTYLA Linn. 777

Houard, No. 5356.

Lonicera Periclymenum Linn. 112. Common Honeysuckle.

,, Flower swollen. See No. 777.

ORNEODES HEXADACTYLA Linn. 778

Houard, No. 5359.

Homoptera Flowers deformed, small, and greenish. Floral leaves and the discoloured bracts are irregularly contorted and rolled. Aphis bright green with black cornicles.

SIPHOCORYNE XYLOSTEI Schrank 779

Syn. *Aphis xylostei* Koch.

Buckton, ii., 25. Connold, Veg. Galls, pl. 127 ; Plant Galls, fig. 136. Houard, No. 5358.

Lonicera Xylosteum Linn. 1. Upright Fly Honeysuckle.

Lepidoptera Flowers swollen. See No. 777.

ORNEODES HEXADACTYLA Linn. 780

Houard, No. 5370.

Homoptera Flowers deformed. See No. 779.

SIPHOCORYNE XYLOSTEI Schrank 781

Buckton, ii., 26. Houard, No. 5377.

LEAVES OF THE MEALY GUELDER ROSE *(Viburnum Lantana)* WITH PUSTULAR GALLS CAUSED BY THE PRESENCE OF THE LARVAE OF THE GALL-GNAT *Oligotrophus Solmsii.* THE LOWEST LEAVES SHEW THE CONDITIONS PRESENT ON THE UNDER SURFACE

VALERIANACEAE

Valeriana dioica Linn. 73. Small Marsh Valerian.

Fungi Thickened spots on the leaves and stems bearing the sori, with orange-yellow aecidiospores. May and June.

Aecidial stage of UROMYCES VALERIANAE Schum. 782

Syn. *Aecidium valerianacearum* Duby.

Plowright, p. 128.

Valeriana sambucifolia Mikan. 111. Great Valerian.

Diptera Leaves crumpled, swollen, twisted, and discoloured, with a white larva in the folds. M. E.

DIPLOSIS sp. 783

Trail, 1878. Houard, No. 5422.

Fungi Thickened spots on the leaves and stem. See No. 782.

UROMYCES VALERIANAE Schum. 784

Plowright, p. 128.

Kentranthus ruber D. C. Red Valerian.

Homoptera Flowers and leaves deformed. Flowers hypertrophied, greenish; calyx swollen, toothed, or irregularly lobed at the margin; tube of the corolla very short and very thick, with enlarged greenish lobes, sometimes bent and variously contorted. Leaves revolute, making a large subfusiform gall of a pale green or purplish colour. Sometimes there are swellings on the superior surface of the leaf and the midrib. The margin is always swollen, and numerous papillae are developed on the surface of the gall.

TRIOZA CENTRANTHI Vallot 785

Houard, Nos. 5431, 5433. 786

Valerianella carinata Lois. 16. Carinated Corn-salad.

,, Flowers deformed. Corolla short, swollen, greenish; stamens atrophied; bracts and leaves contorted. When numerous adjacent flowers are attacked they form a cerebriform pale yellowish-green mass. Lateral proliferation also occasionally occurs.

TRIOZA CENTRANTHI Vallot 787

Houard, No. 5398.

Valerianella dentata Poll. 82. Narrow-fruited Corn-salad.

,, Flowers deformed. See No. 787.

TRIOZA CENTRANTHI Vallot 788

Connold, Plant Galls, fig. 94 (without name). Swanton, Knowledge, June, 1910. Houard, No. 5397.

DIPSACEAE

Dipsacus sylvestris Huds. 74. Wild Teasel.

Nematoda Development arrested, bulbous swellings at the base of the stem, with deformed shoots.

TYLENCHUS DEVASTATRIX Kühn 789

Connold, Plant Galls, p. 191. Houard, No. 3445 (without name).

Scabiosa Columbaria Linn. 72. Small Scabious.

Acari Flowers aborted, swollen, forming a greyish pubescent mass. Terminal leaves dwarfed, swollen, and closely covered with abnormal whitish hairs.

ERIOPHYES SQUALIDUS Nalepa 790

Connold, Plant Galls, figs. 276, 277. Houard, No. 5464 (without name).

CAMPANULACEAE

Jasione montana Linn. 80. Sheep's Bit.

,, Whole plant enlarged, leaves, buds, and flowers usually very velvety or hairy; floral leaves sometimes reddish. The capitulum is rarely normal, sometimes more or less atrophied, often changed into a tuft of little velvety leaves.

ERIOPHYES ENANTHUS Nalepa 791

Houard, No. 5552.

Campanula Trachelium Linn. 59. Nettle-leaved Bellflower.

Coleoptera Seed capsules much swollen, one or two black larvae pupate in each.

MIARUS CAMPANULAE Linn. 792

Syn. *Gymnetron campanulae* Linn.
Houard, No. 5495.

Campanula rapunculoides Linn. 24. Creeping Bellflower.

Capsule swollen. See No. 792.

MIARUS CAMPANULAE Linn. 793

Houard, No. 5501.

Campanula rotundifolia Linn. 111. Hairbell.

Capsule swollen. See No. 792.

MIARUS CAMPANULAE Linn. 794

Connold, Plant Galls, p. 113. A. Müller, 1876, p. 19. Houard, No. 5510.

Diptera Flowers swollen. Calyx normal, corolla remaining closed, not thickened, hardish, pale green, then bluish on one side. Stamens thickened. Larvae gregarious. M. E.
CONTARINIA CAMPANULAE Kieffer 795
Syn. *Cecidomyia campanulae* Müller.
Connold, Plant Galls, p. 245. Houard, No. 5511.

,, Axillary buds resembling a little onion bulb. The terminal leaves are often attacked, and the galls are closely adjacent.
PERRISIA TRACHELII Wachtl. 796
A. Müller, 1871*b*, p. 8. Houard, No. 5513. 797

Campanula Rapunculus Linn. 31. Rampion Bellflower.
Coleoptera Capsule swollen. See No. 792.
MIARUS CAMPANULAE Linn. 798
Houard, No. 5531.

Campanula patula Linn. 30. Spreading Bellflower.
,, Capsule swollen. See No. 792.
MIARUS CAMPANULAE Linn. 799
Houard, No. 5533.

COMPOSITAE

Eupatorium cannabinum Linn 98. Hemp Agrimony.
Lepidoptera Small swelling in the neighbourhood of a node.
PTEROPHORUS MICRODACTYLUS Hüb. 800
Houard, No. 5556.

Solidago Virgaureae Linn. 110. Golden-rod.
Homoptera Leaves of the axillary buds with margins bent upwards, discoloured, slightly swollen, and abnormally hairy in parts. Aphis garnet-red, with long cylindrical black cornicles.
MACROSIPHUM SOLIDAGINIS Fabr. 801
Syn. *Siphonophora solidaginis* Fabr.
Buckton i., 156. Houard, No. 5562.

Bellis perennis Linn. 112. Common Daisy.
Nematoda Stem swollen and distorted.
TYLENCHUS DEVASTATRIX Kühn 802
Bd. Agric. Leaflet, No. 46.

Aster Tripolium Linn. 88. Sea Starwort.
Diptera Inflorescence deformed.
TEPHRITIS PLANTAGINIS Hall 803
Houard, No. 6238.

Erigeron canadense Linn. Canadian Fleabane.

Homoptera — Leaf margins thickened, discoloured, yellowish, becoming slightly rolled in a screw-like manner. Aphis bright green, body pilose and slightly tufted with bristles.

APHIS MYOSOTIDIS Koch 804

Houard, No. 5577.

Filago Germanica Linn. 96. Common Cudweed.

,, — Inflorescence distorted, leaves more downy than usual. Aphis yellowish-green with black antennae and eyes, and plentifully covered with a white powder.

PEMPHIGUS FILAGINIS Fonsc. 805

Buckton iii., 129. Houard, No. 5590.

Inula crithmoides Linn. 19. Golden Samphire

Diptera — Receptacle swollen, hard, without projections above. Multilocular. M. G. Imago, August, September, I.

MYOPITES INULAE Roser 806

Houard, No. 5626.

,, — Receptacle swollen, hard, without projections above. Multilocular. M. G. Imago, August, September, I.

MYOPITES FRAUENFELDI Schiner 807

Houard, No. 5625.

Pulicaria dysenterica Gray. 79. Fleabane.

,, — Receptacle swollen, almost woody. Imago, spring, II.

MYOPITES INULAE Roser 808

Houard, No. 5635.

,, — Receptacle swollen, almost woody. Imago, spring, II.

MYOPITES FRAUENFELDI Schiner 809

Houard, No. 5634.

Achillea millefolium Linn. 112. Milfoil.

,, — Capitulum not ripening, there is no visible deformity or hypertrophy.

TEPHRITIS DIOSCUREA H. Löw 810

Houard, No. 5679.

,, — Spherical, fleshy, unilocular gall at the junction of root and stem, about the size of a pea. Often gregarious. Larva white. M. G. Imago, June and July.

OXYNA FLAVIPENNIS H. Löw 811

Syn. *Tephritis flavipennis* H. Löw.
Houard, No. 5682.

THE COMMON MILFOIL *(Achillea Millefolium)* WITH GALLS CONTAINING THE LARVAE OF THE GALL-GNAT *Rhopalomyia millefolii*

Diptera Roots swollen near the stem.
TRYPETA GUTTULARIS Meigen 812
Syn. *Carpotricha guttularis* Meigen.
Connold, Plant Galls, p. 246. A. Müller, 1876, p. 18.

" Capitulum on the bud transformed in a hairy, subglobose, spongy gall, 5 to 20 mm. in diameter, white or tinted with red. Plurilocular.
RHOPALOMYIA PTARMICAE Vallot 813
Trail, 1878. Houard, No. 5676, 5681. 814

" Flowers, leaves, and stems attacked. Galls about the size and shape of a hemp seed, green at first, becoming reddish, black at maturity ; opening at the summit star-like, with 4 or 5 rays. Interior lined with hairs, and containing a single yellow larva. The galls are either solitary or coalescent, in the latter state some imes forming a bunch as large as a filbeit nut at the base of the stem. M. G. Imago, spring, II. (Plate XXXI.)
RHOPALOMYIA MILLEFOLII H. Löw 815
Syn. *Hormomyia millefolii* H. Löw. 816
Connold, Plant Galls, fig. 327. Swanton, Knowledge, 817
June, 1910. Houard, No. 5673, 5680, 5685, 5691. 818

Homoptera A little depression on the lower surface of the leaf, with a raised area on the corresponding superior surface.
APHALARA NERVOSA Förster 819
Scott, 1881*b*, p. 18. Houard, No. 5689.

Nematoda Leaves and petioles swollen and distorted, bearing globular growths about the size of a hemp seed. Solitary or gregarious and coalescent, yellowish-green, becoming brown. Each gall contains numerous eel-worms. June tc October. (Plate XVI.)
TYLENCHUS MILLEFOLII F. Löw 820
Connold, Veg. Galls, pls. 77, 97 (in the latter the galls 821
are wrongly ascribed to *Rhopalomyia millefolii*) ; Plant Galls, fig. 328. Houard, No. 5684, 5688.

Achillea Ptarmica Linn. 112. Sneezewort.

Diptera Entire head of the plant transformed into a spongy, hairy, subglobose mass, 30 mm. in diameter, white or tinted rose colour, surrounded by numerous leaves. Cavities numerous, containing many larvae. M. G. Imago, spring, I.
RHOPALOMYIA PTARMICAE Vallot 822
Syn. *Hormomyia ptarmicae* Vallot.
Inchbald, 1860, p. 164. Connold, Plant Galls, p. 246. Houard, No. 5706.

Diptera — Galls resembling hemp seed on various parts of the plant. See No. 815.

RHOPALOMYIA MILLEFOLII H. Löw 823

Trail, 1878. Houard, No. 5703, 5707. 824

Anthemis Cotula Linn. 76. Fetid Chamomile.

Coleoptera — Receptacle deformed, globular and subovoid (the normal form is an elongated cone), becoming twice as thick as the base of a healthy one. Its wall is thick and hard; the ovoid cavity contains a white larva. M. G. Imago, spring, I.

APION LAEVIGATUM Payk 825

Houard, No. 5667.

„ — Receptacle elongated, cylindrical, hard, with an ovoid cavity containing one or more larvae. M. G. Imago in September.

APION SORBI Herbst. 826

Houard, No. 5668.

Anthemis arvensis Linn. 73. Corn Chamomile.

„ — Receptacle elongated. See No. 826.

APION SORBI Herbst. 827

Houard, No. 5663.

Chrysanthemum Leucanthemum Linn. 112. Great White Oxeye.

Diptera — Pea-like fleshy galls on the top of the root, containing numerous larval cells the size of a millet seed.

TEPHRITIS PROBOSCIDEA H. Löw 828

Houard, No. 5734.

Homoptera — Leaf deformed and bent. See No. 850.

APHIS CARDUI Linn. 829

Houard, No. 5739.

Tanacetum vulgare Linn. 105. Tansy.

Diptera — Stem, leaves, and flowers attacked The galls are very like those induced by the larvae of *Rhopalomyia millefolii*, H. Löw (see No. 815); the teeth at the aperture are rather more sharply pointed. Solitary or gregarious, each gall containing a single flesh-coloured larva. M. G. 830
Imago, spring, I. 831

RHOPALOMYIA TANACETICOLA Karsch 832

Syn. *Hormomyia tanaceticola* Karsch.

Connold, Plant Galls, fig. 291. Houard, No. 5750, 5752, 5754.

Diptera Capitulum swollen.

DIPTERON sp. 832*a*

A. Müller, 1870*b*, p. 5; Fitch, 1879, p. 259. Houard, No. 5751.

Artemisia Absinthium Linn. 74. Common Wormwood.

" Twig swollen.

OXYNA TESSELLATA H. Löw 833

Syn. *Tephritis tessellata* H. Löw.

Houard, No. 5765.

Artemisia vulgaris Linn. 110. Mugwort.

" Very small, ovoid pustules on all parts of the upper surface of the leaf. M. G. and M. E. Imago, escaping by an aperture on the superior surface.

RHOPALOMYIA FOLIORUM H. Löw 834

Syn. *Cecidomia foliorum* H. Löw.

Fitch, 1881, p. 22. Connold, Plant Galls, p. 132. Houard, No. 5824.

Homoptera Leaves deformed, thickened and folded downwards; the terminal ones are bunched; bright red or golden-yellow. Aphis greyish-black with reddish eyes. 835

CRYPTOSIPHUM ARTEMISIAE Pass. 836

Connold, Plant Galls, pp. 132, 133. Houard, No. 5819, 5825.

Tussilago Farfara Linn. 112. Colt's-foot.

Fungi Slightly thickened, yellow spots on the leaves, often surrounded by a violet margin. Spores orange-yellow. June and July.

Aecidial state of PUCCINIA POARUM Nielsen 837

Syn. *Aecidium compositarum* Mart., var. *Tussilaginis* Persoon.

Plowright, p. 168.

Senecio vulgaris Linn. 112. Common Groundsel.

Diptera Flower receptacle swollen, forming an ovoid gall containing numerous larvae. M. G.

UROPHORA MACRURA H. Löw 838

Connold, Plant Galls, p. 245.

Senecio Jacobaea Linn. 112. Common Ragwort.

Lepidoptera Stem swollen. M. G. Imago, spring, I.

PHALONIA ATRICAPITANA Steph. 839

Syn. *Conchylis atricapitana* Steph.

Houard, No. 5868.

Diptera Capitulum slightly swollen, with a little cone covering the larva.

PHORBIA SENECIELLA Meade 840

Houard, No. 5863.

" Involucres greatly swollen, usually tinted red at the base. Larvae gregarious, yellowish-white, living amongst the florets. M. E.

STICTODIPLOSIS JACOBAEA H. Löw 841

Syn. *Diplosis jacobaea* H. Löw.
Houard, No. 5865.

" Capitulum greatly swollen, sometimes thrice the normal size ; ovoid, fleshy, remaining green. The orange-coloured larvae occupy a cavity below the receptacle.

CECIDOMYIA sp. 842

Trail, 1878. Houard, No. 5864.

Fungi Elongated fusiform swellings on the petioles and midribs, bearing the black sori with dark brown spores. August to November.

PUCCINIA GLOMERATA Greville 843

Connold, Plant Galls, fig. 253.
Plowright, p. 209.

Senecio aquaticus Hill. 111. Marsh Ragwort.

Lepidoptera Stem swollen.

PLATYPTILIA ISODACTYLA Zell. 844

Houard, No. 5861.

Diptera Capitulum swollen. See No. 842.

CECIDOMYIA sp. 845

Trail, 1878. Houard, No. 5858.

Senecio Sarracenicus Linn.

Lepidoptera Stem swollen.

PLATYPTILIA ISODACTYLA Zell. 846

Houard, No. 5851.

Arctium majus Linn. 44. Common Burdock.

Diptera Seed capsules swollen and deformed. Larvae solitary or gregarious. June to August. M. G.

TRYPETA BARDANAE Schrank 847

Syn. *Tephritis bardanae* Sch.
Connold, Veg. Galls, pl. 124; Plant Galls, fig. 80. Houard, No. 5891.

Cnicus lanceolatus Will. 112. Spear Thistle.

" Floral receptacle hypertrophied, gall hard, plurilocular.

TRYPETA JACEAE Rob. Desr. 848

Houard, No. 5910.

Diptera Floral receptacle hypertrophied, gall hard, plurilocular.
UROPHORA STYLATA Fabr. 849
Houard, No. 5909.

Homoptera Leaves rolled, bent, or otherwise deformed, discoloured. Aphis reddish brown or golden-yellow, with a large spot on the dorsum, and black cornicles.
APHIS CARDUI Linn. 850
Buckton, ii., 92.

Cnicus arvensis Hoffm. 112. Creeping Thistle.

Diptera Rounded or fusiform swelling, usually near the top of the stem (sometimes the involucres are affected), hard, glossy, greenish or brownish, attaining the size of a walnut, or even, according to Houard, "la dimension du poing." Larval cavities numerous, each with a single occupant. M. G. Imago, June, I.
UROPHORA CARDUI Linn. 851
Connold, Veg. Galls, pl. 33; Plant Galls, fig. 292. 852
Houard, Nos. 5925, 5929.

Cnicus heterophyllus Willa. 58. Melancholy Thistle.

,, Floral receptacle hypertrophied, without induration, containing a plurilocular gall.
TEPHRITIS CONURA H. Löw 853
Houard, No. 5913.

Centaurea nigra Linn. 112. Black Knapweed.

,, Floral receptacle transformed into a hard, cylindrical or ovoid gall, usually containing three cells, each inhabited by a single larva. M. G.
UROPHORA SOLSTITIALIS Linn. 854
Connold, Veg. Galls, pl. 125; Plant Galls, fig. 144.
Houard, No. 5964.

,, Fusiform swellings on the midrib, veins or petiole; green, surrounded later by a violet or yellow border. Larva yellow. M. E. 855
LOEWIOLA CENTAUREAE F. Löw 856
Connold, Plant Galls, fig. 143 (without name). Swanton, Knowledge, June, 1910.

,, Capitulum swollen, hardened, plurilocular. M. G. Imago, July, August, I.
TEPHRITIS ELUTA Meigen 857
Houard, No. 5966.

Centaurea scabiosa Linn. 82. Great Knapweed.

Hymenoptera Large elongated swellings, or small rounded projections, on the stems, striated longitudinally. Colour normal, larval cells numerous. M. G. Imago, May, I.

AULAX SCABIOSAE Giraud 858

Syn. *Aulax centaureae* Thoms.

Connold, Plant Galls, fig. 86. Houard, No. 5988.

" Irregular oviform swelling, about the size of a pea, on the midrib at the extreme base of the leaf. Colour slightly paler than that of the non-affected part.

AULAX FITCHI Kieffer 859

Fitch, 1877, p. 124. Connold, Plant Galls, p. 93 (without name). Swanton, Knowledge, June, 1910. Houard, No. 5991.

Acari Well-defined rounded pustules, 2 to 4 mm. in diameter, on the radical leaves, projecting from both surfaces, chiefly on the inferior; colour greenish, becoming dark violet or black at maturity. Opening situated in the centre of a depression on the upper surface. (Plate XXI. 4.)

ERIOPHYES CENTAUREAE Nalepa 860

Houard, No. 5989.

Lapsana communis Linn. 112. Nipplewort.

Homoptera Irregular bending and folding of the leaf. Aphis grass-green, slightly reddish on the head; cornicles long, pale green. Aphides abundant in early June on the under surface of the leaves.

MACROSIPHUM ALLIARIAE Koch 861

Syn. *Siphonophora alliariae* Koch.

Buckton, i., 124. Houard, No. 6030.

Crepis paludosa Moench. 62. Marsh Hawk's-beard.

Hymenoptera Stem swollen.

CYNIPS sp. 862

Fitch, 1879, p. 259. Houard, No. 6125.

Hieracium Pilosella Linn. 110. Mouse-ear Hawkweed.

Diptera Gall ovoid, often 10 mm. in diameter, velvety, formed by the rolling of a deformed leaf round the atrophied shoot. Larvae gregarious, white, becoming red. M. G. Cocoon white.

MACROLABIS PILOSELLAE Binnie 863

Syn. *Cecidomyia pilosellae* Binnie.

Binnie, 1877, p. 179. Connold, Plant Galls, p. 245. Houard, No. 6199.

Diptera Capitulum swollen, containing one to four white larvae.
TEPHRITIS RURALIS H. Löw 864
Houard, No. 6196.

Nematoda Flower-head swollen, remaining closed, stalk contorted, sometimes cocted on its axis; yellowish-green.
TYLENCHUS HIERACII Connold 865
Connold, Plant Galls, fig. 124. Trail, 1883. Houard, No. 6198 (without name).

Hieracium vulgatum Fries. 90. Common Hawkweed.

Hymenoptera Longitudinal or rounded swellings on the roots and stem, greenish-yellow and pubescent at first, becoming brown and glabrous. June to August. Larvae yellow. M. G.
AULACIDEA HIERACII Bouché 866
Syn. *Aulax hieracii* Sch.
Connold, Veg. Galls, pl. 38; Plant Galls, fig. 125 (as on *H. sylvaticum* Gouan, but this is doubtful). Houard, No. 6165.

Acari Leaf margin rolled upwards and serrated.
ERIOPHYES LONGISETUS Nalepa 867
Trail, 1885. Houard, No. 6167.

Hieracium boreale Fries. 96. Savoy Hawkweed.

Hymenoptera Swellings on stem and roots. See No. 866.
AULACIDEA HIERACII Bouché 868
Inchbald, 1865, p. 46. Connold, Plant Galls, p. 114. Houard, No. 6145.

Diptera Swollen and woody ovary.
TRYPETA RETICULATA Sch. 869
Trail, 1878, p. 66; Fitch, 1879, p. 257. Connold, Plant Galls, p. 245. Houard, No. 6142 (without specific name).

,, Leaf folded.
MACROLABIS CORRUGANS F. Löw 870
Syn. *Cecidomyia corrugans* F. Löw.
Connold, Plant Galls, p. 245.

Hieracium umbellatum Linn. aggr. 88. Umbellate Hawkweed.

,, Capitulum swollen, containing one to four larvae.
CARPOTRICHA PAPILLATA Fallén 871
Fitch, Entomologist, 1879, p. 257. Houard, No. 6151.

Hypochaeris radicata Linn. 111. Long-rooted Cat's-ear.

Hymenoptera Elongated fusiform swellings (rarely rounded) on the stems and petioles, often in such numbers as completely to deform the plant. Yellowish-green, brownish upon maturity. Larval cells numerous, each containing a yellowish-white larva. June to October. M. G. Imago, spring, II. (Plate XXIX. 1, 2.)

AULAX HYPOCHAERIDIS Kieffer 872

Connold, Veg. Galls, pl. 39; Plant Galls, fig. 85. Houard, No. 6036.

Diptera Achenes swollen, rounded, brown, marked with longitudinal ridges. The gall is thin walled, about 3 mm. in diameter. Larva white.

TRYPETA sp. 873

Trail, 1878, p. 65. Houard, No. 6033.

Nematoda Midrib of the leaf with an elongated irregular swelling of a yellowish-green tint. The gall is not infrequently formed on the blade, and is then more or less rounded.

ANGUILLULI sp. 874

Trail, 1885. Houard, No. 6040.

Leontodon autumnale Linn. 112. Autumnal Hawkbit.

Diptera Capitulum closed and swollen.

TEPHRITIS LEONTODONTIS De Geer 875

Houard, No. 6057.

Taraxacum officinale Weber. 112. Dandelion.

Fungi Confluent or solitary elongated swellings on the midrib of the leaf and the petiole.

PROTOMYCES PACHYDERMUS Thüm 876

Plowright, p. 300.

" Minute pustules on the leaves and involucres. Entire plant much dwarfed.

SYNCHYTRIUM TARAXACI De Bary 877
878

Sonchus oleraceus Linn. 111. Sharp-fringed Sowthistle.

Diptera Capitulum remaining closed, involucral bracts hypertrophied.

TEPHRITIS FORMOSA H. Löw 879

Houard, No. 6109.

RADICAL LEAVES (A, UPPER SURFACE ; B, THE LOWER) OF CORN SOW-THISTLE *(Sonchus arvensis)* WITH NUMEROUS PUSTULAR GALLS CAUSED BY THE PRESENCE OF THE LARVAE OF THE GALL-GNAT *Cystiphora sonchi*

Sonchus arvensis Linn. 112. Corn Sow-thistle.

Diptera Gregarious circular patches on the radical leaves; green at first, becoming red or purple, glabrous or glossy. The swelling is the more pronounced on the superior surface. Each gall contains a white larva. M. G. Imago appearing in the autumn. (Plate XXXII.)

CYSTIPHORA SONCHI F. Löw 880

Syn. *Cecidomyia sonchi* Connold.

Connold, Plant Galls, fig. 279. Houard, No. 6100.

ERRATA

The galls on Blackthorn leaves described on pp. 94 and 197, and figured in Plate XXI., Fig. 1, are caused by *Eriophyes padi* Nalepa, not by *Eriophyes similis* Nalepa. The galls which result from the presence of *Eriophyes similis* on Blackthorn leaves are whitish, with an elongated hairy aperture (often with purplish margin) on the upper surface of the leaf.

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DESCRIPTIONS OF THE PLATES

PLATE I

FIG.

1. Upper surface of an oak-leaf, showing peripheral death in summer, resulting from the presence of galls of *Andricus ostreus*. ($\frac{5}{6}$.)
2. Lower surface of the same leaf, with galls of *Andricus ostreus*, and scars where others had fallen away. ($\frac{5}{6}$.)
3. Lower surface of an oak-leaf, with two galls of *Neuroterus lenticularis*. ($\frac{5}{6}$.)
4. Three galls on midrib of an oak-leaf caused by the presence of the larvae of *Andricus ostreus*. ($\frac{5}{1}$.)
5. Scar after detachment of gall of *Andricus ostreus*. ($\frac{5}{1}$.)

PLATE II

1. Galls of *Pontania proxima* on leaves of *Salix fragilis*—(*a*) (*a*) fully developed on the lower surface; (*b*) (*b*) ditto on upper surface; (*c*) immature galls of second brood on young leaves. ($\frac{5}{6}$.)
2. Gall showing position of orifice. ($\frac{3}{1}$.)
3. Section. ($\frac{3}{1}$.)
4. Gall of *Pontania pedunculi* on lower surface of leaf of *Salix caprea*. ($\frac{5}{6}$.)
5. Upper surface of the leaf. ($\frac{5}{6}$.)
6. Section of gall, showing frass. ($\frac{3}{1}$.)
7. Larva. ($\frac{5}{1}$.)
8. *Pontania salicis*. ($\frac{5}{1}$.)
9. Gall of *P. salicis* on lower surface of leaf of *Salix purpurea*. ($\frac{1}{2}$.)
10. Upper surface of the leaf. ($\frac{1}{2}$.)
11. Section of gall. ($\frac{3}{1}$.)

PLATE III (*Frontispiece*)

1. Gall of *Rhodites rosae* on bud of *Rosa canina*. ($\frac{1}{2}$.)
2. Section of gall of *R. rosae* in its early state. ($\frac{1}{2}$.)
3. Section of mature gall of *R. Rosae*, showing larval cavities. ($\frac{2}{1}$.)
4. Galls of *Rh. rosarum* on leaflets of *Rosa canina*. ($\frac{1}{2}$.)
5. A detached gall of *Rh. rosarum*. ($\frac{1}{1}$.)
6. *Rhodites rosarum*. ($\frac{4}{1}$.)
7. Galls of *Rhodites eglanteriae* on leaflets of *R. canina*. ($\frac{1}{2}$.)
8. Section of gall of *Rh. eglanteriae*, showing larval cavity, and two o inquilines. ($\frac{4}{1}$.)
9. Larva of *Rh. eglanteriae*. ($\frac{3}{1}$.)
10. *Rhodites eglanteriae*. ($\frac{3}{1}$.)

PLATE IV

FIG.

1. Gall in an oak-bud arising through the presence of the larvae of *Biorrhiza pallida.* ($\frac{5}{8}$.)
2. Ditto. ($\frac{5}{8}$.)
3. *Biorrhiza pallida* ♂. ($\frac{7}{3}$.)
4. Ditto ♀. ($\frac{7}{3}$.)
5. Galls of *Biorrhiza aptera* on oak-root. ($\frac{1}{1}$.)
6. Ditto, section. ($\frac{1}{1}$.)
7. Section. ($\frac{2}{1}$.)
8. Section, with wasp emerging. ($\frac{2}{1}$.)
9. *Biorrhiza aptera.* ($\frac{7}{3}$.)

PLATE V

1. Galls of *Neuroterus baccarum* on staminate flowers of the oak. ($\frac{1}{2}$.)
2. Section of a gall. ($\frac{2}{1}$.)
3. *Neuroterus baccarum* ♀. ($\frac{7}{3}$.)
4. (*a*) (*a*) Galls of *Neuroterus lenticularis.* ($\frac{1}{2}$.)
   (*b*) (*b*) Ditto of *Neuroterus fumipennis.* ($\frac{1}{2}$.)
5. Section of gall of *N. lenticularis.* ($\frac{4}{1}$.)
6. Early stage of gall of *N. lenticularis.* ($\frac{4}{1}$.)
7. *Neuroterus lenticularis.* ($\frac{10}{3}$.)
8. (*c*) Gall of *Neuroterus vesicator.* ($\frac{1}{2}$.)
   (*d*) Ditto of *N. albipes.* ($\frac{1}{2}$.)
9. (*e*) Galls of *Neuroterus numismatis.* ($\frac{1}{2}$.)
   (*f*) Ditto of *N. laeviusculus.* ($\frac{1}{2}$.)
10. Section of gall of *N. laeviusculus.* ($\frac{4}{1}$.)
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12. Section of gall of *N. numismatis.* ($\frac{4}{1}$.)
13. Gall of *N. numismatis.* ($\frac{2}{1}$.)
14. Gall of *Neuroterus tricolor.* ($\frac{1}{2}$.)
15. Section of gall of *Neuroterus fumipennis.* ($\frac{4}{1}$.)

PLATE VI

1. Normal flower-spike of *Plantago media.* ($\frac{5}{8}$.)
2. Flower-head of *P. media* galled by larva of *Mecinus pyraster.* ($\frac{5}{8}$.)
3. *Mecinus pyraster.* ($\frac{5}{1}$.)
4. Gall caused by larvae of *Ceuthorrhynchus hirtulus* on root of *Erophila verna.* ($\frac{1}{1}$.)
5. *Ceuthorrhynchus hirtulus.* ($\frac{5}{1}$.)
6. Gall of *C. hirtulus.* ($\frac{2}{1}$.)
7. Branch of *Populus tremula* attacked by *Saperda populnea.* ($\frac{1}{2}$.)
8. Ditto, with galls caused by the presence of the larvae of *Saperda populnea.* ($\frac{1}{2}$.)
9. *Saperda populnea* ♀. ($\frac{4}{3}$.)
10. Ditto ♂. ($\frac{4}{3}$.)
11. Larva of *S. populnea.* ($\frac{4}{3}$.)

PLATE VII

FIG.

1. *Polygonum aviculare*, with galls caused by the presence of the larvae of *Augasma aeratella*. ($\frac{1}{1}$.)
2. *Augasma aeratella*. ($\frac{4}{3}$.)
3. Longitudinal section of gall of *A. aeratella*. ($\frac{2}{1}$.)
4. Leaf of *Populus tremula*, with the petiole hypertrophied through the presence of the larva of *Nepticula argyropeza*. ($\frac{5}{6}$.)
5. *Nepticula argyropeza*. ($\frac{7}{3}$.)
6. Stem of *Epilobium parviflorum*, with gall caused by the presence of the larva of *Mompha decorella*. ($\frac{1}{2}$.)
7. *Mompha decorella*. ($\frac{2}{1}$.)
8. Resinous gall of *Rhyacionia* (*Retinia*) *resinella* in shoot of *Pinus sylvestris*. ($\frac{1}{2}$.)
9. *Rhyacionia resinella*. ($\frac{4}{3}$.)
10. Section of gall of *R. resinella*, showing the larval cavity. ($\frac{1}{2}$.)

PLATE VIII

1. *Veronica Chamaedrys*, with gall caused by the presence of the larvae of *Perrisia veronicae*. ($\frac{1}{1}$.)
2. *Perrisia veronica* ♂. ($\frac{8}{1}$.)
3. Larva of *P. veronicae* amidst the white hairs of the gall. ($\frac{5}{1}$.)
4. Twig of *Salix fragilis*, with leaves galled by larvae of *Perrisia terminalis*. ($\frac{1}{2}$.)
5. *Perrisia terminalis* ♂. $\frac{10}{1}$.
6. Pupa of *P. terminalis*. ($\frac{5}{1}$.)
7. Twig of *Tilia vulgaris*, with galls caused by the presence of the larvae of *Contarinia tiliarum*. ($\frac{1}{1}$.)
8. Section of gall, showing larvae. ($\frac{2}{1}$.)
9. Under surface of leaf of *Quercus pedunculata*, with galls caused by the presence of the larvae of *Macrodiplosis dryobia*. ($\frac{1}{2}$.)
10. Aspect of upper surface of ditto. ($\frac{1}{2}$.)
11. Larvae of *M. dryobia* ($\frac{6}{1}$.)

PLATE IX

1. Galls caused by the presence of the larvae of *Oligotrophus annulipes* on the upper surface of leaves of *Fagus sylvatica*. ($\frac{1}{1}$.)
2. Under surface of an attacked leaf. ($\frac{4}{3}$.)
3. A withered leaf retaining chlorophyll around two galls. ($\frac{1}{1}$.)
4. Section of gall of *O. annulipes*, showing cavity with larva. ($\frac{8}{1}$.) (The line to the left of the section indicates the actual length of a crawling larva.)
5. *Oligotrophus annulipes*. ($\frac{8}{1}$.)
6. Lower surface of leaves of *Cornus sanguinea*, with immature galls of *Oligotrophus corni*. ($\frac{1}{2}$.)
7. Leaves of ditto, with mature galls. ($\frac{1}{1}$.)
8. Section of gall of *O. corni*, showing pupa in cavity. ($\frac{1}{2}$.) (It is placed incorrectly ; the aperture should be below.)
9. Pupa of *O. corni*. ($\frac{7}{1}$.) (The line immediately above it indicates the actual length.)
10. Twig of *Salix caprea*, with galls caused by *Rhabdophaga salicis*. ($\frac{1}{2}$.)
11. Section of same, showing the larvae. ($\frac{1}{1}$.)

PLATE X

FIG.

1. *Chermes strobilobius*, larval fundatrices *on* bud of *Picea excelsa*. ($\frac{4}{3}$.)
2. Buds of *Picea excelsa*, with galls caused by *Chermes strobilobius*. ($\frac{1}{1}$.)
3. Third-year shoot of *Larix europaea*, as seen at the end of March, with larvae and eggs, one larva at base of each bud. ($\frac{4}{3}$.)
4. Larva and eggs. ($\frac{9}{1}$.)
5. Eggs of exules on leaf of *Larix europaea*. ($\frac{4}{1}$.)
6. Eggs of sexuparae on ditto. ($\frac{4}{1}$.)
7. Part of shoot of *Larix europaea*, with colonici, exules, and winged sexuparae. ($\frac{4}{3}$.)
8. Exule with pupal skin. ($\frac{9}{1}$.)

9, 10. Winged sexuparae. ($\frac{9}{1}$.)

PLATE XI

An apple-tree branch, with numerous tumours associated with *Myzoxylus laniger* (= *Schizoneura lanigera*). ($\frac{1}{2}$.)

PLATE XII

1. Galls on leaflets of *Fraxinus excelsior*, caused by the presence of *Psyllopsis fraxini*, showing at (*a*) early state, (*b*) mature gall, (*c*) appearance of leaflet after departure of the insects. ($\frac{2}{3}$.)

2, 3, 4. *Psyllopsis fraxini*. ($\frac{5}{1}$.)

5. Leaves of *Populus nigra*, with galls caused by *Pemphigus affinis*, showing at (*d*) early, and (*e*) mature galls. ($\frac{2}{3}$.)
6. Galls on twig of *Populus nigra*, caused by *Pemphigus bursarius* ($\frac{2}{3}$.)
7. *Pemphigus bursarius*, apterous viviparous ♀. ($\frac{5}{1}$.)
8. Ditto, pupa. ($\frac{5}{1}$.)
9. Leaf of *Populus nigra*, with its petiole galled by *Pemphigus spirothecae*. ($\frac{1}{2}$.)
10. *Pemphigus spirothecae*, apterous viviparous ♀. ($\frac{5}{1}$.)

PLATE XIII

1. Leaf of *Acer psendo-platanus*, with galls caused by *Eriophyes macrorrhynchus*. ($\frac{1}{2}$.)
2. Two galls. ($\frac{5}{1}$.)
3. Section of a gall. ($\frac{5}{1}$.)
4. Aperture of gall of *E. macrorrhynchus* on lower surface of leaf. ($\frac{5}{1}$.)
5. Unicellular hair from gall of *E. macrorrhynchus*. ($\frac{20}{1}$.)
6. *Eriophyes macrorrhynchus*. ($\frac{250}{1}$.)
7. Leaf of *Acer campestre*, with galls caused by *Eriophyes macrorrhynchus*. ($\frac{1}{2}$.)
8. Galls in various stages of development. ($\frac{5}{1}$.)
9. Section through three galls and midrib of the leaf. ($\frac{5}{1}$.)
10. Aperture (lower surface of leaf) of three galls. ($\frac{5}{1}$.)
11. Leaf of *Acer campestre*, with two galls caused by *Eriophyes macrochelus*. ($\frac{1}{2}$.)
12. Gall. ($\frac{3}{1}$.)
13. Section of gall. ($\frac{3}{1}$.)

FIG.
14. Pluricellular hair from interior of gall of *E. macrochelus.* ($\frac{20}{1}$.)
15. Felt of hairs between the axils of the larger veins on the under surface of leaf of *Acer pseudo-platanus,* caused by *Phyllocoptes acericola.* ($\frac{5}{1}$.)

PLATE XIV

Fagus sylvatica. The dense mass of twigs on the trunk are said to have arisen through the presence of a species of *Eriophyes.*

PLATE XV

Leaves of *Achillea millefolium,* with galls caused by the presence of *Tylenchus millefolii.* ($\frac{9}{7}$.)

PLATE XVI

1. Stems of *Veronicae Chamaedrys,* with tumours resulting from the presence of *Sorosphaera veronicae.* ($\frac{1}{2}$.)
2. Stem of *Urtica dioica,* with gall caused by *Aecidium urticae,* the aecidial stage of *Puccinia caricis.* ($\frac{1}{2}$.)
3. Stems of *Holcus mollis,* galled by *Epichloe typhina.* ($\frac{1}{2}$.)
4. Stems of *Alnus glutinosa,* galled by *Frankiella alni.* ($\frac{1}{2}$.)
5. Section of a mass of tubercles. ($\frac{1}{2}$.)

PLATE XVII

Branch (dead) of *Abies pectinata,* with swelling bearing a "witch's broom," caused by the presence of the aecidial stage (*Peridermium elatinum*) of *Melampsora cerastii.*

PLATE XVIII

Part of frond of *Pteris aquilina,* with the margins of the pinnules incurved and thickened through the presence of the larvae of *Perrisia filicina.*

PLATE XIX

Branch of *Juniperus communis,* with gouty swelling consequent upon the attack of *Gymnosporangium clavariaeforme.* The bodies containing the teleutospores ot the fungus are growing upon the hypertrophied part of the stem.

PLATE XX

Betula alba, with numerous "witches' brooms" caused by *Eriophyes rudis.*

PLATE XXI

1. Shoot of *Prunus spinosa,* with leaves galled by *Eriophyes similis.* ($\frac{1}{2}$.)
2. Leaves of *Alnus glutinosa,* with galls caused by the presence of *Eriophyes laevis.* ($\frac{1}{2}$.)
3. Section of gall of *E. laevis.* ($\frac{4}{1}$.)

FIG.

4. Radical leaf of *Centaurea Scabiosa*, with galls (early state) caused by *Eriophyes centaureae*. ($\frac{1}{2}$.)
5. Leaves of *Viburnum Lantana*, galled by *Eriophyes viburni*. ($\frac{1}{3}$.)
6. Gall of *E. viburni*. ($\frac{4}{1}$.)
7. Ditto, showing aperture on under surface of leaf. ($\frac{4}{1}$.)
8. Ditto, section. ($\frac{6}{1}$.)
9. Shoot of *Taxus baccata*, with bud galled by *Eriophyes psilaspis*. ($\frac{1}{2}$.)
10. Bud of *Taxus baccata*, galled by *Eriophyes psilaspsis*. ($\frac{1}{1}$.)

PLATE XXII

1. Bud of *Quercus pedunculata*, galled by the larva of *Dryophanta similis*. ($\frac{1}{1}$.)
2. Ditto. ($\frac{2}{1}$.)
3. Leaf of *Q. pedunculata*, with galls caused by the presence of the larvae of *Dryophanta longiventris*, the alternate generation of the preceding. ($\frac{1}{1}$.)
4. Section of gall, with *D. longiventris* that has just emerged from its cell. ($\frac{4}{1}$.)
5. Buds, with galls arising from the presence of the larvae of *D. Taschenbergi*. ($\frac{2}{1}$.)
6. Leaf, with cherry-like galls caused by the presence of the larvae of *Dryophanta folii*. ($\frac{5}{8}$.)
7. Withered leaf, with gall of *D. folii*. ($\frac{5}{8}$.)
8. *Dryophanta folii*. ($\frac{7}{8}$.)
9. Spring leaves of *Q. pedunculata*, with gall on leaf and one on petiole, caused by the presence of the larvae of *Dryophanta verrucosa* (after Adler). ($\frac{1}{1}$.)
10. Ditto, on leaf (after Adler). ($\frac{2}{1}$.)
11. Ditto, in a bud (after Adler). ($\frac{2}{1}$.)
12. Galls caused by the presence of the larvae of *Dryophanta divisa*, the agamous generation of the preceding. ($\frac{1}{2}$.)

PLATE XXIII

Leaves of *Ulmus montana*, galled by *Oligotrophus Leemei*—(*a*) distorted young leaves, with galls on the midrib; (*b*) upper surface of leaf, showing apertures of galls; (*c*) (*c*) two leaves, showing the under surface with numerous galls on the midrib. ($\frac{1}{1}$.)

PLATE XXIV

Papaver dubium, showing two normal capsules, and one galled by the presence of the larvae of *Aulax papaveris*, causing it to become swollen and to droop. ($\frac{1}{1}$.)

PLATE XXV

A branch of *Prunus insititia*, bearing four normal fruits, and three that are greatly hypertrophied through the presence of the fungus *Exoascus pruni*. ($\frac{1}{1}$.)

PLATE XXVI

FIG.

Stems of *Rubus plicatus*, galled by the fungus *Coniothyrium Fuckelii.* ($\frac{1}{1}$.)

PLATE XXVII

Seed vessels and stem of *Oenanthe crocata*, with galls caused by the presence of the fungus *Protomyces macrosporus.*

PLATE XXVIII

Convolvulus arvensis, with the midribs of the leaves much hypertrophied and distorted through the presence of *Eriophyes convolvuli.*

PLATE XXIX

1. Flowering stem of *Hypochaeris radicata*, with gall resulting from the presence of the larvae of *Aulax hypochaeridis.* ($\frac{1}{1}$.)
2. Ditto, much galled and with abortive flower. ($\frac{1}{1}$.)
3. Ditto, a transverse section, showing the larval cavities. ($\frac{1}{1}$.)
4. *Aulax hypochaeridis.* ($\frac{7}{1}$.)

5, 6. Stems and leaves of *Nepeta hederacea*, with galls resulting from the presence of the larvae of *Aulax glechomae.* ($\frac{1}{2}$.)

7. Section of gall of *A. glechomae*, showing the larval cells. ($\frac{1}{2}$.)
8. Larva. ($\frac{5}{1}$.)
9. *Aulax glechomae.* ($\frac{5}{1}$.)

PLATE XXX

Leaves of *Viburnum Lantana*, with galls caused by the presence of the larvae of *Oligotrophus Solmsii.* The lowest leaves show the under surface of the galls. ($\frac{1}{1}$.)

PLATE XXXI

Leaves and stems of *Achillea millefolium*, with galls caused by the presence of the larvae of *Rhopalomyia millefolii.* ($\frac{1}{1}$)

PLATE XXXII

Radical leaves of *Sonchus arvensis*, with galls caused by the presence of the larvae of *Cystiphora sonchi.* ($\frac{1}{1}$.)

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Whitby (Beatrice). THE RESULT OF AN ACCIDENT.

White (Percy). A PASSIONATE PILGRIM.

Williamson (Mrs. C. N.). PAPA.